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In Front of the Console

In this issue, I contacted and got permission from the authors of two writings that appeared in other publications. I called them “In Others’ Words.” It is heartening to hear from others that they value us and our domes.

In the one from Jack Schreder of Redding, California, he makes a strong case for keeping open the school planetarium that bears his family’s name. They are arguments that some of us have made ourselves as we worked to keep our domes open. Sometimes they work, and sometimes they do not.

In Schreder’s case, the school board has relented a bit and agreed to fund the planetarium for another year. It will be interesting to follow what happens.

The second “In Others’ Words” article calls for a planetarium in Mobile, Alabama. It is an opinion piece, not a letter to the editor.

Alabama’s planetariums

I did some research on planetariums in Alabama and discovered there are 13 that run the gamut from a portable in a park to the most sophisticated projectors. There are three with opto-mechanical projectors: the Wernher von Braun Planetarium, by the way, was the world’s first with a proscenium stage. I know quite a bit about the United State’s space program, but virtually nothing about the USSR’s program.

I did not know, for example, that instead of facilities on land the USSR used ships to support their space program. One recounts the fun and excitement of chasing the March eclipse to Indonesia, and the second is about the fleet of communication ships used for the country’s space program. There has been a lot of activity since those days.

In September.

The remaining four have fulldome capability. In addition to Montgomery, they are Jacksonville State University, Jacksonville; Muscle Shoals High School in Muscle Shoals (closed); Christenberry Planetarium at Samford University in Birmingham (closed).

Besides Montgomery, there is not a strong planetarium presence in Alabama’s cities. The only two in Birmingham are closed, and neither Auburn University nor the University of Alabama in Tuscaloosa (Roll Tide) have one.

So, I agree with Kevin Lee: Mobile does need a planetarium.

If there were awards for such things, I also would give Lee a trophy for this great line: “...youngsters are likely to see more celestial bodies in a bowl of Lucky Charms than they will in the backyard.” Well said, Kevin.

Following Allie’s planetarium

There is a third “reprint” in this issue, but it is quite different from the two I’ve mentioned. It is an article from the Independent Appeal in Selmer, Tennessee, telling about a senior project undertaken by determined student Allie Ray.

As I said in the story (starting on page 16), I chanced upon Allie’s Gofundme drive to raise money for her high school’s planetarium and followed it through the school year. What she accomplished, through community support, is amazing.

We have two stories from Russia in this issue, which I think is a record for Planetarian. One recounts the fun and excitement of chasing the March eclipse to Indonesia, and the second is about the fleet of communication ships used for the country’s space program. There is a planetarium onboard the ship, of course.

I am always fascinated when I read the news from Russia. As someone who grew up in the space race and moon landings, I know quite a bit about the United State’s space program, but virtually nothing about the USSR’s program.

I did not know, for example, that instead of facilities on land the USSR used ships to act as communication command posts for space missions, satellites, Mir, and the ISS. The Cosmonaut Viktor Patsayev was even called back into to service to help NASA when Hurricane Rita virtually shut down the gulf coast in 2005.

Wouldn’t that make a great movie? A hero ship, coming out of retirement to help save the day. It brings to mind the 2000 Australian movie The Dish: (I won’t tell you more about it, other than if you’re at all interested in the moon landing and laughing a lot, then be sure to watch it.)

Russia: keep the stories coming. Now if I could only get some stories from Spain, por favor. (Yes, that is a hint.)

Coming in September

I am already working on the September issue and am excited about a story that will include. Right at deadline we learned about a research paper authored by Manfred Cuntz and Levent Gurdemir from the University of Texas at Arlington, and Martin George from Tasmania, that is making the news.

Martin, of course, is a past president of IPS, from the Launceston Planetarium at the Queen Victoria Museum.

Levent is director of the Planetarium at UTA, and Manfred is a professor in the Department of Physics.

Not only are planetarians involved with the writing and research, but the paper also deals with planetarium software, historical detective work, the Pleiades, and ancient literature. That is all I’m saying for now.

10 years=40 issues

Speaking of Martin George: he was president when I became editor of Planetarian. That was 10 years ago, and this issue in your hands (or on your screen) is my 40th. When I did the math, it didn’t seem possible that I have edited 40 issues, and now here I am, teasing you with my 41st in September.

I will continued editing as long as I can because this is one of the best jobs in the world (outside of the dome, that is). It is you, the Planetarian reader, who makes it so fun—so keep sending me stories and great pictures, and we’ll keep up the good work of sharing with our peers.

1 I used the IPS Directory of the World’s Planetariums, Loch Ness Productions’ online compendiums, and, with thanks, a list prepared by Mel Blake at the University of North Alabama.

2 Lucky Charms is a sugary breakfast cereal that has marshmallow “charms,” originally pink hearts, yellow moons, orange stars, and blue diamonds.
Dear Fellow Planetarians

I'm excited! We are about to begin our IPS 2016 Conference in Warsaw. This is the event that will help us to recharge, reimagine, and redesign our planetariums. We'll be joined by hundreds of planetarians who face the same challenges, and are ready to share their ideas.

Our host, the Copernicus Science Centre, has been organizing and preparing for all of us to connect with the international community. On June 19, hundreds of planetarians, many suffering from jetlag, will emerge on the scene. Every individual brings their unique experiences and by sharing we help each other learn and grow.

The days that follow will be filled with the very best of new ideas, new technologies, new teaching methodologies, old friends and new faces. IPS2016 in Warsaw, Poland is the place to be!

A couple of days prior to the Conference, the IPS Council, our governing body, will be meeting to plan the future of IPS. The idea is, if we're not looking beyond today, we won't be here for tomorrow. New ideas will be presented by our Vision 2020 team, which is made up of some of the most innovative, inspiring, and creative leaders in our industry. We'll be tantalized with plans for our IPS 2018 Conference in Toulouse, France. We'll have a glimpse of exciting possibilities for our IPS 2020 Conference. We'll also discover who among us are potential candidates for IPS Offices. WOW! Exciting adventures ahead!

And, if all of this is not thrilling enough for you, there's more! We are honored and thrilled to partner with the City of Brno of the Czech Republic and the Brno Observatory and Planetarium in presenting the IPS Fulldome Festival Brno 2016.

The Festival will be held the week prior to IPS 2016. We will be viewing all the latest fulldome films produced in the past two years as well as meet the very talented men and women who created them. This Festival is our best opportunity to select those new films only you know will be perfect for your planetarium audiences.

By the time you read this, I will have shopped for some new clothes, attempted to lose a couple of pounds, and reviewed Roberts Rules of Order. Because I am a vendor IPS president, those of you who are attending the conference will probably see more of me than you care to. Please come and talk to me. I cherish those opportunities. Collaborating with you to spark new ideas, to open doors we never knew existed, to be inspired...well, that's the way I like it.

We're in this together!

Dr. Jack Schreder
Redding, California USA

In 1975, when I assumed the position of county superintendent of schools, one of my first acts was to become fiscally independent from the county of Shasta, which provided greater efficiency, transparency, and opportunities to provide more education services to constituents.

We were able to purchase surplus property from the Redding Elementary School District (Magnolia Street School) and house our entire operation in one location. The model for our administration was to enhance vocational education, special education, pre-school, and staff development and create a stimulus to improve science and mathematics programs.

We wrote several federal and state grants applications to fund these programs, including federal science grants to build a planetarium. The capital facilities and equipment for the planetarium were federally funded and the operation and staffing were our responsibility. Through the years, we recruited the best and brightest to create stimulating programs that, over the years, have received national acclaim.

Two of the most recent planetarium directors, Brian Grigsby and David Ewart, have worked diligently to maintain a reputable planetarium to bring science to life. Until recently, the planetarium served between 6,000 and 8,000 students a year for a total of over 260,000 students in the first 30 years of the program offerings. Lately the attendance has dropped significantly. What happened?

When you cut staff to bare bones level, reduce offerings in content and frequency, triple the cost of a ticket, all but eliminate public information regarding the planetarium, what would you expect? It takes commitment, expertise, and financial support to provide a quality educational offering. The current minimal staff is on life support and doesn't know what to expect.

Over the years, I have had many anecdot al references offered by planetarium attendees reflecting the positive influence on their scientific interest. I don't know what influenced Elon Musk1 or two boys in a garage in Palo Alto2 that transformed apricot orchards in suburban San Jose to Silicon Valley, but I do know that a simple light switch in a planetarium can ignite and illuminate limitless creative thought.

With considerable attention on the new science, technology, engineering, and math programs (STEM), what better time to showcase a unique educational offering in the North State? To close or not fully support a valuable community asset at a time when there are historically high interest levels in space and related fields does not appear to be an enlightened educational leadership strategy. Once the planetarium is closed, it’s closed.

(Continues on page 11)

1 Elon Musk is the founder and CEO of SpaceX, and co-founder and CEO of Tesla Motors
2 Referring to Dave Packard and Bill Hewlett, the founders of Hewlett-Packard
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Visualize your Imagination
Kevin Lee
Arts Editor
Lagniappe Weekly
Mobile, Alabama
USA

With Mobile’s recent attempts to lure new industry, museums count more than ever. Yet there’s a weak spot in our magnificent array of cultural and educational facilities that would put us over the moon, in more ways than one.

Mobile needs something that sets sights higher than the sky. Mobile should have a planetarium.

As a Birmingham kid, I didn’t have to head out of town to see the heavens’ glory. All I had to do was go up the hill to Meyer Planetarium at Birmingham-Southern College where the planets, stars and galaxies rolled by in astounding fashion. Combined with a space race that was at its apex, it set the imaginations of my peers ablaze with dreams of interplanetary and interstellar discovery.

Fast forward to my time in an astronomy class at the University of South Alabama. Our professor, Dr. Neal Rowell, often lamented the lack of opportunity for fieldwork in the Mobile area by explaining how the combination of light pollution, inclement weather and humidity made for poor stargazing.

The last of those is the worst culprit. It makes our daily summertime skies hazy as opposed to the near-cobalt canopy in higher and drier locales. It also scatters light at night, opposed to the near-cobalt canopy in higher and drier locales.

Museum Director Jan McKay said. She pointed to the real estate squeeze on their block and how “Most of the labs and the lectures I have, it’s just pictures, but we can’t show them for real. You want to show them for real but a planetarium would be the next best thing to give them a look at what we’re missing,” Gapud said.

South Alabama Professor Emeritus Dr. Kent Clark—“I call him ‘Man-super,’” Gapud quipped—echoed his younger colleague’s perspectives. He also nodded toward economic realities.

“A planetarium is just an educational tool. You would have to have shows to make it a going concern but it’s great for kids because you can do a lot of things with a planetarium you can’t do at an observatory,” Clark said.

Gapud noted the Gulf Coast Exploreum as a natural spot for such a facility. They have particular limitations, though.

“If we had more room maybe, but you know we’re so landlocked,” Gulf Coast Exploreum Director Jan McKay said. She pointed to the real estate squeeze on their block and how the facility is tightly nestled up to the History Museum of Mobile.

She said their IMAX theater wouldn’t allow conversion due to its construction. They could show films on astronomical subjects but that might be about it.

“I absolutely adore planetariums. I worked at a natural history museum and helped to build a planetarium and I’m actually frustrated with the lack of astronomy education going on in the region. I’d love to see a really 30-foot dome with a clear ceiling height of 25 feet or so usually holds close to 100 attendees. The only way they could have that at the Exploreum would be to sacrifice their oft-used courtyard.

With the growing private sector involvement in space exploration, it might seem worthwhile to infect as many kids with galactic-level dreams as possible. If only there were an enthusiastic new industry in town with an identity in flight or aerospace, perhaps they could help out in some way.

Though they’re sorely unrecognized, we already have a couple of astronauts and a rocket scientist from Mobile. How many more could we boast if our children were infused with the wonder of the universe they don’t normally get to glimpse? ☆

1Referring to French company Airbus’ first manufacturing facility in America, recently opened in Mobile.

Ralph Waldo Emerson once asked what we would do if the stars only came out once every thousand years. No one would sleep that night, of course. The world would create new religions overnight. We would be ecstatic, delirious, made rapturous by the glory of God. Instead, the stars come out every night and we watch television.

— Paul Hawken’s. Commencement address, University of Portland, 2009

Spacequotations.com
Narrate by Benedict Cumberbatch

SUPERVOLCANOES

- Winner Best Immersive Fulldome Jackson Hole Wildlife Film Festival 2013
- Award Winner South Korean Planetarium Festival 2012
- Award Winner Jena Fulldome Film Festival 2013
The important work of my planetarium—and all planetariums

Suhas B. Naik-Satam  
Programme Coordinator  
Nehru Planetarium  
Nehru Centre, Mumbai, India

Since ancient days, humans have never ceased to wonder at the splendour of the starry sky. This curiosity and quest of knowledge of the stars gave birth to the imaginary forms of the various constellation. Viewed in this context, it is not at all surprising that astronomy is one of the most ancient of sciences.

Until the beginning of the 19th century, teaching of astronomy has been confined to the classroom and, for practical purpose, to the actual starry heavens.

Now 99 years have passed since the first planetarium was built and began serving as a visual aid in learning astronomy.

The purpose of Nehru Centre is to inculcate and promote a rational outlook of life, to promote the cause of education, and to undertake research in sciences and technology, all for the advancement and emancipation of our people.

The planetarium part of Nehru Centre was inaugurated on 3 March 1977 by the then Prime Minister Smt. Indira Gandhi. Over the years, this has grown into a centre for astronomy and space science outreach.

Many programmes

Nehru Planetarium has so far created 35 astronomical presentations, 28 of them by using the Carl Zeiss Mark IV Universal Projector. Over 14 million people have viewed and enjoyed these shows.

Creating a planetarium programme is more of an art than a science. It involves the interaction of scientists, artists, communicators, musicians, technicians like sound recordists, photographers, and a host of others. Once the theme is chosen, a team of researchers collect basic information. It is checked and re-checked and a preliminary script is written. This is then tested in the planetarium dome for its feasibility and operational convenience.

After several trials, a working script is drafted and this is sent to various scientists and communicators for their expert comments. The script is finalised after rounds of discussions over a number of days and nights, taking into consideration the comments received from a wide variety of people from different fields.

Taking their input, changes are then incorporated into the script, and it is discussed along with the music. The script is also translated into Hindi and Marathi.

After the interaction with music directors, narrators, and other artists, the commentary in three languages is recorded. Casting music for planetarium programmes is a pleasurable experience itself. For each programme the music is specially cast and blended with commentary and visuals to make the sky show more exciting.

Since the shows are visited by children as well as others, the programme is made as simple as possible, while at the same time remaining interesting for the adult audience. So far, the Nehru Planetarium Mumbai has produced 30 major planetarium programmes on various topics, including the titles Tryst with Destiny, Galileo to Galileo, Cosmic Life, This Violent Universe, 4000 BC to 2000 AD—Evolution of Astronomy, Universe in Seven Steps, Comets to Stars, Secret Life Of Stars, Stars In the Lime Light, Hide and Seek in the Sky, and Fireworks in Space.

In order to make the programme more admired, theatrical effects like Galileo watching the night sky in the year 1610 (in the programme Galileo to Galileo) and the landing of extra-terrestrial beings on Earth (in the programme Cosmic Life) are introduced. These live appearances have a thrilling impact on the audience and contribute immensely to success of the programme.

In the meantime, the technology has marched ahead. To keep abreast, Nehru Centre installed a Digistar-3 projector in 2003. This new equipment is a bank of eight computers that have the latest data of the sky loaded onto them. All the advantages of digital imagery are thus brought to the fingertips of the operator. The computers send the information to six high-resolution video projectors that cover the entire dome.

In addition to the major programmes, short or “mini” programmes were also produced. Man in Space, Man on Moon, Discovery of Planet Uranus, Total Solar Eclipse in India, Sun, Moon, and Conjunction of Planets in the year 1982 are some of these.
Planetarium outreach activities

The planetarium arranges popular lectures by well-known scientists from the country and abroad. Courses on astronomy are conducted for students and general public. The planetarium also shows films on various scientific topics. To create interest in astronomy and general science, the planetarium arranges various contests like quizzes, essays, astro-paintings and astro-poetry. It also arranges special exhibitions.

Among the outreach activities of Nehru Planetarium is the dissemination of information in astronomy through the concept of the “mini-planetarium”. This planetarium on wheels consists of a projector capable of projecting 960 stars in a collapsible dome. Being portable and compact, it can readily be set up in any classroom of area of 150 square feet and can accommodate a class of 30-40 students. The mobile exhibitions on astronomy, together with a portable mini-planetarium, are sent out to villages and district towns to reach and serve a wider cross section of the people.

Telescopes are kept outside the planetarium for sky watching of the night sky. These telescopes are also being taken to various places, particularly to villages.

Schools are encouraged to send their student groups and avail themselves of concessional free facility. The groups from Mumbai Municipal Corporation schools, children from economically weaker sections, and physically challenged students see our shows for free, of course with prior arrangement and merit.

Versatility of the dome

One can teach, apart from astronomy and other sciences, geography, history, and even poetry under the dome. The planetarium had arranged poems under the sky in which some of the works of great poets were read out under the background of the starry sky. There were also programmes titled “Music Under the Stars” in which well-known musicians performed under the artificial night sky.

In fact, all museums should have planetariums as one of their major activities. The presence of a planetarium in any place will attract a large number of audiences. One can teach everything under the sky, be it science or arts, under this umbrella of planetarium dome. In fact, one can make a planetarium programme to suit any subject which the museum is supposed to popularize.

Influence cannot be quantified

Whereas many of these activities are quantifiable by statistical figures, what is not quantifiable is the fact that a whole generation of students has grown up with the Nehru Planetarium in Mumbai and the impact the planetarium has created on their thoughts and action. Over the past 28 years, thousands of children have become regular visitors to the planetarium and many hundreds have been deeply involved in its activities.

The knowledge that one gains in the virtual atmosphere of the planetarium show would attempt anyone to watch the real night sky for years to come!

Indeed, a planetarium compels the soul to look upwards and teaches the philosophy “A man’s reach should exceed his grasp, or what is heaven for?”

In a very subtle manner, science and art do complement each other. And the planetarium does play a major role in emphasizing this relation.

1Robert Browning, in the poem “Andrea del Sarto.”

(Redding, continued from page 6)

Since Proposition 13 passed in 1978, revenue for civic center facilities has been incorporated into the Shasta County Office of Education. In addition, private citizens have contributed funds and contributed countless volunteer hours in support of the planetarium. ChH Hill has forgone its Christmas party and contributed over $140,000 from an annual fundraiser to support the planetarium and WES Camp. The SCOE administration has publicly stated that funds are available. It’s a matter of priority.

The county board of education has the authority to approve the budget and that will occur in the next two months. We encourage their support of the planetarium.

While the planetarium issues have been discussed periodically in the last year, most discussion at the board meetings has been limited and in some cases mixed with other financial matters. The planetarium is a stand-alone project that warrants an evening public hearing to assess the community support of the program. When the possible closure of the planetarium was posted on Facebook, there were over 1,100 likes in support of the planetarium within 36 hours.

I have been accused of having a vested interest because 37 years ago the Shasta County board of education chose to name the planetarium after my family. You’re right; I do have a vested interest, not because of the name, but because of what it is, a planetarium, an asset that has stimulated interest in science for countless young and old alike.

Here’s an idea. Fully fund the planetarium. License the naming rights of the planetarium to the highest bidder to augment the budget and move ahead.☆

(Edtor’s Note: This letter also appears in the Redding, California Record Searchlight and is reprinted here with Mr. Schreder’s permission. A response to Mr. Schreder’s letter also appears in the newspaper and can be read at www.redding.com/opinion/speak-your-piece/as-education-needs-and-budgets-change-planetarium-struggles-32801583-41ef-7bd5-c053-0100007fca07-37886476l.html.)

At press time, it appears that the facility will be budgeted for at least one more year.)

Dr. Jack Schreder, former county superintendent of schools in Shasta County, Redding, California, also was the first president of Region 1 Association of California School Administrators. His bachelor’s degree is from Michigan State University; his master’s, from San Francisco State University, and doctorate from Stanford University. jschreder@jschreder.com

The wonder is, not that the field of stars of so vast, but that man has measured it.

—Anatole France

The Garden of Epicurus, 1894.

Spacequotations.com
Introduction to Learning Seasons

Real-time simulation software that recreates an interactive virtual universe have been part of the landscape of fulldome planetariums for over a decade. Much has been written about their capabilities (e.g., Emmart 2005; Wyatt 2005; Lantz 2011). It has been argued that digital planetariums have the potential to be powerful educational tools (Yu 2005), since audiences can experience places or phenomenon that would otherwise be difficult or impossible to observe in real life; and visualizations can dynamically present astronomical phenomena from multiple vantage points.

Yet there have been few studies of their effectiveness. I recently published an experimental study of fulldome planetariums for astronomy education in the context of large-scale undergraduate classes (Yu et al. 2015). Here I summarize the results and elaborate on what they mean for the planetarium community.

An impetus for the research is the difficulty of learning seasons, including the many commonly held but inaccurate conceptions attached to the topic (see review by Sneider, Bar, & Kavanagh 2011). The ease by which scientifically incorrect mental models can take hold can be explained in part by the complexity of the correct mental model. The cause of the seasons is difficult to learn, because of the large number of concepts that learners need to understand before they can have a complete conceptual understanding.

Sub-concepts can be divided between those involving views of the phenomena from the surface of Earth (e.g., changing altitude of the noon-time sun over the course of a year, the changing length of day, variations by latitude) and those pertaining to seeing the Earth-sun system from space (e.g., Earth as a sphere, Earth's tilt with respect to the ecliptic, Earth's axis remaining constant through its orbit, Earth's eccentric orbit, Earth is closest to sun during the northern winter).

Yet textbook diagrams explaining the seasons tend to show only the sun-Earth system from a heliocentric viewpoint. Students are asked to conceptualize time-varying, 3D abstractions using static 2D diagrams. The projected Earth orbit in Figure 1a (based on a similar diagram found in the popular textbook by Bennett, Donahue, Schneider, & Voit 2007) can lead to the erroneous idea that Earth’s orbit is highly elliptical (Yu, Sahami, & Denn 2010), and seasons are due to the Earth being closer and further in its orbit (Ojala 1997).

Even the top third of the diagram highlighting the tilt of the Earth with respect to the oncoming sunlight can lead to surprising false conclusions, such as equatorial regions are warmer because they are closer to the sun; and the northern hemisphere tilts closer to the sun in summer and further in winter (Ojala 1997). Textbook diagrams also typically re-scale the sun-Earth system to make them visible on paper, but by doing so can lead to new or reinforce old misconceptions, by making the two bodies appear closer in size and closer together in distance than they really are.

Even when a textbook shows a ground view of the different paths of the sun across the sky, such as in Figure 1b, also based on a similar figure from Bennett et al., there again can be problems because a dynamic 3D system is compressed into a static 2D view. Again students are asked to conceptualize the 3D abstractions using 2D descriptions.

In order to have a full understanding of the seasons, the ground perspective in Figure 1b has to be linked to the space-bound perspective of Figure 1a. The learner has to be able to translate from an Earth-bound reference frame to a space-based heliocentric one, requiring skills such as understanding 3D relationships from 2D representations, imagining how an object appears from a different...
perspective, and having the ability to mentally rotate objects (Barnea & Dori 1999). If a student is deficient in such spatial visualization abilities, then it may be more difficult to learn from such diagrams. This suspicion is bolstered by research suggesting that spatial ability skills correlate with the ability to learn conceptual astronomy knowledge (Heyer 2013, Plummer, Kocareli, & Slagle 2013).

Computer visualizations have been suggested as ideal for correcting unscientific ideas in astronomy (Yu 2005). Astronomical scale, sizes, and three-dimensional relationships can be shown accurately. Instead of assuming that the viewer can imagine how a ground-based perspective relates to a space-based one, we show that relationship. The audience is transported inside the simulation to witness phenomena at different scales and viewpoints, seeing from internal as well as external perspectives.

There has already been some prior work to suggest that such an approach with computer visualizations has promise. In tests involving space science virtual simulations on classroom desktop computers, students showed better learning gains compared to control groups (Trundle & Bell 2003; Hansen et al. 2004). Recently digital planetarium visuals were shown to be effective for teaching celestial motions to elementary schoolchildren, especially when both Earth- and space-based perspectives were used (Plummer 2009; Plummer, Kocareli, & Slagle 2013).

Methodology

The research study highlighted here is part of the Astronomy Learning in Immersive Virtual Environments (ALIVE) project, a US National Science Foundation-funded collaboration between the Denver Museum of Nature & Science (DMNS) and the Metropolitan State University of Denver (MSUD). Test subjects were undergraduate students enrolled in a one-semester MSUD introductory astronomy course, which covered topics in solar system, galactic, and extragalactic astronomy.

The experimental phase was preceded by a development period, when a suite of interactive demonstration modules were created for Sci’s Uniview visualization platform, and a multiple choice test database was generated for use in the weekly curriculum tests to gauge student understanding. These quizzes contained questions that acted as a pre-test for upcoming lectures, covered current instruction, and tested retention of knowledge from earlier instruction.

Seventeen classes (spread almost evenly between two instructors) were divided into three groups: Group I classes saw no visualizations; students in Group II classes were exposed to Uniview virtual environment instruction in the classroom; Group III students experienced the Uniview instruction in DMNS’ Gates Planetarium (a 17-m dome tilted by 25°, with seating for 120; Neafus & Yu 2007). Students in a Group II class saw the visualization modules projected onto a flat display screen in two different classrooms equipped with an XGA (1024 × 768 resolution) projector.

The screens were 2 m and 2.3 m across, with the classroom seating organized such that students were located 3-12 m away, resulting in the displays appearing 11-29° across.

There were, respectively, 3, 5, and 9 classes taking part in Groups I, II, and III. The total number of students contributing quiz results to the final analysis were 548, 643, and 555, respectively for the pre-instruction, contemporaneous with instruction, and post-instruction curriculum quiz questions. Because the seasons instruction was paired with a second astronomy topic to be taught with Uniview, only half an hour out of the entire semester was spent on teaching the seasons.

The visualization modules for Groups II and III were flown live by a navigator, while the instructor for the class lectured following a preset outline. The seasons lecture followed the recommendations of Willard & Roseman (2007). The first line of understanding involves the role of sunlight in warming the surface of Earth. To help them build an accurate mental model, students were exposed to a variety of examples of the phenomena of seasons. The lesson began by showing the diurnal motion of the sun at different times of the year, and from different latitudes on Earth. This allowed students to become familiar with patterns of the seasons from Earth, before being exposed to space-based perspectives.

Next the students were shown to how the path of the sun changes seasonally, to counter the belief that the sun passes through the zenith when observed from mid-latitudes (Plummer 2009). Finally, to explain Earth’s motion and orientation with respect to the sun, the virtual camera switched from the Earth-based viewpoint of the sun in the sky to the space-based one, presenting the amount and angle of illumination of Earth by the sun at different times of the year.

(Continues on page 14)
(Continues from page 13)

Instead of real-time visualizations, Group I students were presented with additional diagrams and visuals from the textbook presented via PowerPoint, as well as a demonstration from the instructor using a physical globe.

**Results**

In Table 1, we list the pre-instructional, contemporaneous, and post-instructional mean scores (M) for seasons-related questions on the curriculum quizzes for the classes in the three experimental groups. Shown are the percentage test score gains between the contemporaneous and pre-instruction quizzes (Cont-Pre) and the gains between the post- and pre-instructional quizzes (Post-Pre), and 95% confidence intervals (CI).

In Figure 2, we plot the Cont-Pre gains, along with 95% CIs as error bars, for the three experimental groups. Figure 3 shows the Post-Pre gains. The large Group III gain is robust when compared with Group II since their respective 95% CIs do not overlap. However there is some uncertainty about the control classes’ result, since Group I’s CI is wide enough to encompass the Group III CI. This is due to the smaller number of participating Group I students, leading to greater uncertainty about the Group I mean, which is reflected in the size of its CI.

There were 51, 125, and 102 students for whom we have test scores for the Pre-, Cont-, and Post-quiz categories, respectively. However, due to attrition in student numbers over the semester, the number of students present for both the Post- and Pre- quizzes was only n = 39, leading to a wide CI of ±11.1%. In comparison, there were more Group I students (n = 97) who were present for both the Cont- and Pre- quizzes, resulting in a narrower CI of ±8.2% in Figure 2.

**Why is the Digital planetarium effective?**

We identify three reasons why larger learning gains show up for Group III students versus their counterparts in the other groups: the immersive experience, the simulated virtual environment, and the lower quality Group II experience.

The use of a virtual environment has three main benefits. First, it accurately represent the true size, scale, orientation, and position of solar system objects, which can contradict commonly held misconceptions about the result is also consistent with Plummer et al.’s (2013) finding that showing multiple perspectives provides greater benefits for schoolchildren learning about daily celestial motions. Group I students who only saw 2D representations like those in Figure 1 may not get the instructional support they need for comprehension if they have underdeveloped spatial visualization skills.

Finally, the virtual environment can show time variable phenomena. Patterns of celestial motions in the simulation can be sped up by an arbitrary factor, paused, and repeated from different vantage points, a degree of control more than is possible from a typical animation. Group I students, however, rely again on only static diagrams and verbal descriptions.

In the Post-Pre gain comparison in Figure 3, the Group II gains are consistently lower than those in both Groups I and III. Students viewing the Uniview simulation in the immersive digital dome had consistently larger gains than those who viewed the non-immersive version in their classroom. Why would the same simulation experience shown following the same lecture outline by the same instructors lead to such disparate results? We suspect the non-immersive virtual simulation shown in the classroom is inherently inferior to the experience in the immersive digital planetarium. The classroom display subtended 11-29’, depending on where a student was sitting in the classroom, which meant the size of the imagery was less than 5% of what was visible in the planetarium.

A trade-off exists between the field-of-view (FOV) of the rendered video and the detail that can be discerned from the projected imagery because of the fixed XGA resolution of the classroom projector. Conversely, the FOV can be smaller to keep the fine details visible to students in the back of the classroom, with the compromise that less of the visual content can be seen simultaneously. To follow the sun along its diurnal path, the virtual camera has to pan across the simulated scene with the sun. The view in the dome, on the other hand, shows widely separated spatial phenomena found in the seasons lecture demonstrations with no or minimal additional virtual camera motions, and in full detail. Learners can simply move their heads to follow the virtual scene unfold around them.

Because we have kept the visualizations and instruction to be as similar as possible in both classroom and planetarium, the difference in Group II and III student gains suggest that the immersive experience has a greater impact on student learning. One possible way this might work is related to the limited capacity of working memory; when learning, we are able to hold a limited number of discrete pieces of information in working memory at any given time. In the Group II classroom, the instructor can talk about how high up the sun is at noon on the (Continues on page 24)
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The Story of Allie’s Planetarium

Restoring the stars
McNairy senior works to rebuild school’s planetarium

Feature story in The Jackson Sun, Jackson, Tennessee
Sometime last fall I came across a crowd-source GoFundMe campaign asking for support for a high school senior’s plans to refurbish a long-closed planetarium. I started following Allie Ray’s project and enjoyed watching as a storage room at McNairy Central High School in Selmer, Tennessee slowly became a recognizable planetarium again.

This story speaks to planetarians on many levels. It is the story of a young person seeing a need to bring a teaching tool back to life, and using the vehicle of a required senior project to fill that need.

It is a tale of community and school support, and the mentorship of a special teacher.

It is filled with hope and best practices, especially for all those closed school planetariums, notably in the United States, whose domes now cover storage for old textbooks and maintenance supplies instead of curious upturned faces.

Most importantly, it tells the story of recognizing the need to engage students through the delight of the stars and setting them on courses into science, technology, engineering and math.

To share her story, I decided to take a different route: through her words, in the words of Sarah Allison, her teacher, and a series of pictures from the GoFundme site chronicling their progress (used with permission, of course). More pictures can be seen at the site: www.gofundme.com/hs3awqca. I also have included a reprint of the story that the local Independent Appeal newspaper did about her and her project, just one example of the local and community support the project received.

-Sharon Shanks, Editor

Introduction

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-Sharon Shanks, Editor

Sarah Allison (left) and Allie Ray, preparing to paint.

“Many people are unaware that the planetarium room was actually used for wrestling team practice in the late 1990s and early 2000s, after the projection equipment was removed. It was nicknamed the “Thunder Dome” and still has the painted door to prove it! MCHS no longer has a wrestling team, but will have a planetarium once again. It’s time to paint that door!!”  
-Gofundme report

“This place is shined up!”

“Many people are unaware that the planetarium room was actually used for wrestling team practice in the late 1990s and early 2000s, after the projection equipment was removed. It was nicknamed the "Thunder Dome" and still has the painted door to prove it! MCHS no longer has a wrestling team, but will have a planetarium once again. It's time to paint that door!!”  
-Gofundme report
First, the story in Allie’s words.

Why the planetarium for a project?
I chose this project because I wanted to make a difference—not to mention, this is a pretty cool aspect in our school that no one around my hometown has. My school is a great place and the faculty is wonderful. I wanted to leave my mark before I left, and the planetarium was calling my name.

People thought I was crazy to take on such a huge project, but it has been so rewarding to see my classmates, students from other schools, and the community become as excited as I am to get this space functioning again. There is a desire in the students at McNairy Central to know what a planetarium is, have a class in there, and learn what is beyond this Earth.

What have you learned through the experience?
I have learned that hard work and dedication pay off. There have been many days that I have been discouraged by the negativity of the project, but when I look into the face of eager students and community members who remember it when it was in its prime, I have so much joy and pride.

The grant writing process has been a huge learning stretch for me. I didn’t realize that there was so much time, research, and thought put into it. I could not have been through this whole process without the guidance of Mrs. Sarah Allison and Dr. Ron Butterfield.

What advice would you have for other high school students?
Never give up. Find someone who has the same passion and mindset as you who will help. Mrs. Allison has been tremendous throughout this process. Together, we have been able to make this dream of mine, and hers, come to life.

Also, get your community involved. My community has been a huge help and encouragement. If they back it and want to see it happen, it will happen.

What’s next for you? College? Your major?
After senior projects, which is April 20, I will have my sights set on graduation May 20. As my senior year comes to an end, I am very happy to say that I will be attending the University of Tennessee at Martin in the fall of 2016. Right now, I feel the Lord leading me to major in secondary education, possibly in math or possibly in science. Who knows, I may be able to return to MCHS and teach in my classroom.

Now some words from teacher Sarah Allison

In your view, what is the importance for a planetarium in education?
Our school has a wonderful STEM program, complete with college math and science courses, a mechatronics class, and an engineering class that competes in robotics competitions. This nonfunctional planetarium space exists in our school, and it’s a shame that we aren’t offering astronomy and space education to our students. Many students aren’t even aware that the school houses a planetarium, much less what its use is.

We have a facility that few high schools in the state have and it’s time for us to get this asset back to working order. I feel that space education would round out our STEM program and that our students would leave our school upon graduation with an understanding of space that few students their age possess.

Would networking with other planetariums be helpful in your situation?
Networking with other planetariums will be a necessity. It’s been so long since our school has had a functioning planetarium and astronomy class, any lesson materials that still exist are outdated. We’ll work closely with other planetariums to build a curriculum that meets the needs of our student body, as well as our community.

What are your plans once Allie has graduated?
Allie’s grant writing mentor and I are currently interviewing upcoming seniors who are interested in continuing the project next year. We’re searching for a student with a passion to carry the renovation to the next step, someone who will dive in like Allie did and give their best effort to write grants to ensure the success of this restoration.

Each year, we will continue the grant writing process until the facility is fully funded and the planetarium is fully functioning.

Do you think the grassroots funding will continue?
Local businesses continue to donate and community members continue to ask for progress updates. Every publicized success brings in a few more supporters. While I can’t expect our community to afford the entire renovation, they have been invaluable in getting the project started and keeping Allie’s successes in the news.
This place is shined up! Allie presents her senior project in the planetarium in the morning. She still hasn't heard any results on the grant she wrote several months ago, but through hard work and community support she has raised over $15,400. The room looks great and hopefully we'll have the money for the electronics soon!!

- Gofundme report
MCHS Student Allie Ray aims for the stars with Senior Project

By Christen Coulon and Jeff York

“Shoot for the moon. Even if you miss, you’ll land among the stars.” Norman Vincent Peale

In the past, many Seniors have had lofty goals for their Senior Projects at McNairy Central High School. This year Allie Ray has chosen to shoot for the stars.

Ray is working with her mentors Sarah Allison and Dr. Ron Butterfield to begin restoration of the school’s planetarium which tragically fell into disrepair in the 1990s.

The focus of the project for Ray will be the grant writing process to secure funding for the restoration of the planetarium. This means that Ray can successfully complete her senior project without getting the funding or completing the restoration, however, her mentor Allison said that with Allie’s work ethic she could complete much of the project.

“The goal of her senior project is challenging. She will be practicing the skill of effective grant writing. She will be applying for funding from several donors and foundations this year.

However, it takes a lot of money to bring a planetarium back to life. All money procured through her grant writing will be funneled into the renovation of the once showcased Bobcat Planetarium.

Both Allison and Ray were glad to have gotten the ball rolling on the project.

Allison, a Biology teacher at MCHS, said that she would love to teach a class in the planetarium in the future, but said that she may have to give that position up to Ray after she graduates college.

Ray said she has given some thought to becoming a school teacher focusing her studies on STEM education (science, technology, engineering and math.)

Allison, a 2001 graduate of McNairy Central, said that she wants to bring the stars to her students and said a working planetarium would be a huge asset for the school. She said that Tennessee only has three functioning planetariums within 100-miles of McNairy County and none of those are at a high school. McGavock High is the only high school in the state with a working planetarium.

McNairy Central students have to do a ‘senior project’ as part of their graduation requirements.

The estimated cost of the renovations to the planetarium is $150,000, with the lighting and surround sound costing around $40,000 and the projector costing about $70,000.

Dr. Ron Butterfield, a retired professor at Freed-Hardeman, has taken an interest in the project and could be a key to obtaining grants to help pay for the planetarium.

“He is one of the best grant writers around and still teaches a class on it at Freed-Hardeman,” said Allison. “He is going to be a co-mentor for Allie on her project.”

Dr. Butterfield was at MCHS for a school evaluation in 2006 and inquired about the possibility of restoring the planetarium. Allison was turned down when she broached Dr. Butterfield’s idea to the school’s principal.

The original planetarium opened when the school did in 1969 and has not been in operation in many years.

There is also a Gofundme account that has already gotten attention to help prepare the room for the planetarium. The goal is $6,000 to help professionally clean the room, paint the room and put in new carpet.

“We are going to use the money to give the room a good cleaning,” said an excited Ray. “Our goal is for the room to look new when we get the planetarium working,” in her ever optimistic voice.

The planetarium room now is a storage area for old textbooks and supply items used by the school’s janitors.

If you would like to help fund the project, e-mail Allison at allisons@mc-nairy.org. The Gofundme account is gofundme.com/hs3awqca.)
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Gerhana Matahari—these words meaning “solar eclipse”—became so popular in Indonesia in March of 2016 that its abbreviation GMT (solar eclipse total) was universally understood and used even more often than the full phrase. Astronomers mostly associate this abbreviation with the better-known term Greenwich Mean Time. This is merely a coincidence, but still it emphasizes the importance of the event.

Early in the morning of March 9, the shadow of the moon hit the road from the coast of Sumatra in western Indonesia, then crossed the largest island of Kalimantan (Borneo), touched Sulawesi and other smaller islands, and eventually escaped into the Pacific Ocean.

Thousands descend on Indonesia

Solar eclipses are not only rare, but also spectacular astronomical phenomena. Therefore, thousands of amateur astronomers, “eclipse chasers” from around the world, gathered in Indonesia to enjoy the glorious sight once again and to take photographs of the solar corona, which are also scientifically useful.

As usual, the main plot twist was the weather. In Indonesia, it often rains in March and the sky is overcast. Almost everywhere along the shadow area, the probability of clear weather was 50%. Somewhere the chances were a little better, somewhere a little worse.

Most of the Russian observers went to the resort island Bali from where they could “leap” to the shadow zone. The Siberian team organized by the Irkutsk State University (including also members from Moscow and Novosibirsk) was divided into two parts. One group went to the easternmost island of Pulau Halmahera, where the duration of totality was to be 3 minutes 20 seconds.

Another set off westward to the island of Sumatra, where it could only claim 1 minute 52 seconds of total darkness. The eastbound group included experienced “eclipse chasers” Serguei Yazev (scientific director of the Irkutsk Planetarium) and Michail Gavrilov (the founder of the International Astronomy Olympiad). The westbound group was headed by Serguei Maslikov (director of Large Novosibirsk Planetarium), who also had experience of several eclipses.

Western group: Sumatra

Team Novosibirsk chose southern Sumatra for observation. There, the shadow area covered the ancient city of Palembang with more than a thousand-year history and a population of about 17 million. To get there, we had to take the route Novosibirsk-Hong Kong-Kuala Lumpur-Palembang.

Generally, Indonesia is visa-free for Russians. It is only true, however, when you travel to one of the tourist centers. In our case, we had to get visas upon our arrival in Palembang. The Novosibirsk team of four was almost the first to come there on March 6 and, surprisingly, was met at the airport two more fellow-countrymen.

We found ourselves in the hot and humid tropics, instantly becoming the object of attention from the local folk. This was...
followed for us by three days of “stardom” when everybody wanted to greet us with “Hallo, Mister” and take a picture “for memory.” The issue of the local newspaper on the next day published a large photograph of the “aliens.” It almost seemed that outsiders had set foot on this island since the departure of the Dutch colonizers. The reinforcement of “pale-faces” that arrived the next day made it easier to become Siberians again.

Local authorities had been preparing for the great event well in advance. In March 8-9, a special festival called “Ogoh-Ogoh” was held to cast out evil demons, and the only bridge connecting two halves of the city and the main tourist attraction was closed and given to the observers. Incidentally, the bridge bears the resounding name of Amper, which has nothing to do with the French physicist; it commemorates a local politician.

Palembang was close to the central shadow area and the duration of the total phase of the eclipse was here 1 minute 52 seconds, some 13 seconds less than in the middle of the totality band.

The eclipse began ten minutes after sunrise and was observed low over the horizon. Because of this the observation point was chosen on the riverbank so as to take photographs of the sun on the background of the main bridge, which, in addition, was provided with spectacular backlighting turned on when it was dark. A day before the eclipse, our colleagues from other countries had also sized up this site.

Upon arrival at the observation site at five in the morning, an hour before sunrise, our observers realized that they had underestimated the interest of local people to see the eclipse. The bridge, at 22 meters wide and more than one kilometer long, was already densely crowded with people. Fortunately, it was still possible to find a comfortable place on the pre-selected site on the river embankment, and we installed there the photographic equipment. There was soon no room to swing a cat in this place—like everywhere else.

Will it clear at dawn?

It was still dark. The Siberians were enjoying the wonderful backlighting of the bridge and kept anxiously glancing at the sky, which was covered with fast-moving cumulus clouds. On the previous days, mornings were also cloudy and it even rained, but the sky cleared at dawn. This was what everybody hoped for.

The dawn was gradually breaking, but it was too cloudy for the rising sun to be visible, so neither was it possible to see the partial phases of the eclipse. In the west, on the opposite side of the horizon, the sky was clearing up, but doing so very slowly.

Finally, 20 minutes before the total phase, the sun, which had turned into a narrow crescent resembling a boat, began occasionally to peek out from behind the clouds, each time causing a storm of delight from the audience. It was like a game of hide and seek.

Up to the very last minute, there remained a lingering hope for seeing the solar corona. It was rapidly growing dark. Then, in complete darkness, the backlighting of the bridge was turned on so that the entire city was carried off and exploded with delight.

Alas, the main purpose of the expedition—the solar corona, visible only at the moment of totality—remained hidden behind the clouds. Ironically, as soon as the total phase was over and the dawn broke, the crescent emerged again. Now it was no longer a “little boat” but an “umbrella,” an upward arc.

Sun at the zenith: Strange sight

In this period of the year at the latitude of Palembang (3 degrees south of the equator), the sun passes exactly through the zenith. Its path begins in the east. It rises straight up, passes overhead, and lowers vertically in the west. The moon takes the same path. There

Ampera Bridge is filled by the public during the moment of eclipse. Photo by Sergei Maslikov.
(Seasons, continued from page 14) summer solstice, but the learner has to expend extra effort to decode the visuals—crammed into a rectangular screen in front of the class—to match the verbal description.

In the dome, by contrast, Group III students are aware egocentrically (relative to their own bodies) where the sun is at all times. They get to experience the daily and seasonal motions of the sun from multiple locations on Earth, witness for themselves which directions the sun is rising and setting, how high it rises by noon, and how long it is up in the sky. At the same time, the instructor’s verbal lesson reinforces the location of the sun in summer with descriptions of the longer days that are occurring, the increased time that the ground is heated, the higher elevation angles of the illumination resulting in smaller shadows cast by objects on the ground, and the sunlight being less spread out over the surface. Group III students simply experience the positions and motion of the sun directly. Freed of having to interpret imperfect instructional visuals, a learner will have more cognitive resources to build a mental model of how Earth’s seasons work from what she is seeing and hearing.

Demonstrating seasons by depicting the sun’s changing positions accurately relative to the viewer is one of the key reasons why full-dome is effective for teaching this concept. Perhaps no other topic in astronomy is so suited to be taught in an immersive virtual environment. But are there other topics in other disciplines that are just as tailor-made for the dome? Can geology, physics, chemistry, molecular biology, or archaeology education benefit from this also? There are intriguing hints that computer simulations and immersive virtual environments can aid in teaching topics in other fields as well. How big of an educational role full-dome has in these other subjects will depend now on the interest of educators and vendors in our community.

Acknowledgments
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References


(Eclipse, continued from page 23) studied a small uninhabited island reached by a trimaran and explored various sites in Bouley and its neighborhood. As a possible observation point, the Bouley port pier was chosen and a special rope was purchased to cordon off the observation site.

The morning of March 9 was cloudy. It was quickly decided to deploy observation directly on the veranda of the hotel by the sea where Team East lodged. The observers succeeded in taking photographs of partial phases, but soon the sky became heavily overcast. It started to rain.

Chasing the gap
Because there was a large gap between the clouds moving swiftly along the sky, which made it originally possible to see the initial phases of the eclipse, three team members went by car along the mountain road towards the village of Maba “chasing the gap.”

The only member of the expedition who remained on the site was Mikhail Gavrilov, who managed to photograph the corona during the totality phase with different exposures, as well as capture Bailly’s beads and the “diamond ring” through another gap in the clouds which appeared a little later. Thus, the purpose of the expedition had been accomplished.

The group of observers in the car was not able to see the total phase as the narrow gap between clouds through which they photographed a narrow crescent a few minutes before the total phase then closed and the sun disappeared behind thick clouds. The team made video records of the glow ring during the total phase. Shortly after the end of the total phase, the sun was released from the clouds, which allowed capturing a series of final partial phases of the eclipse.

Now we could breathe a sigh of relief. The expedition task had been completed, largely due to the clever tactic of distributing the forces along the shadow area. Someone was bound to get lucky.

In addition to the eclipse itself, the travelers made a good catch of exotic impressions. The western group has learned something about the life of the local people who created a sort of Indonesian “Venice” along the banks of the full-flowing Musi River. The itinerary also included a visit to the planetarium in Kuala Lumpur (Malaysia) and to the popular science museum Petrosains in the famous Petronas Twin Towers in the same city of KL, as its residents prefer to call it.

The next total solar eclipse is expected on 2017 August 21 in the United States. Hopefully, better luck next time!

From this issue’s International News, we also learn that in addition to Team Novosibirsk, lead by S. Maslikov (west coast) and Team Irkutsk/Moscow, headed by S. Yazev (east coast), there was another group of four persons from Nizhny Novgorod, lead by A. Mitiugov, in the central part of the country.
Experience 8K with DIGISTAR

Milwaukee, Wisconsin

The Milwaukee Public Museum's Daniel M. Soref National Geographic Dome Theater replaces their 1570 film system with Digistar in 8K and joins the expanding list of revolutionary 8K Digistar theaters around the world.
Sharing the story of sight and vision in the planetarium: A new free program

In 2009 Interstellar Studios, in partnership with Imiloa Astronomy Center in Hawaii and Buhl Planetarium at the Carnegie Science Center in Pittsburgh, Pennsylvania, collaborated on the planetarium program Two Small Pieces of Glass for the International Year of Astronomy (IYA). The program was distributed free to IPS members with traditional planetariums and for the cost of materials (hard drive and shipping) for digital fulldome facilities.

The program was well received and still shows today in a number of domes around the world. A documentary called 400 Years of the Telescope was the companion to the program and played on Public Broadcast Stations in the US and Canada. Both were funded by a National Science Foundation grant.

Over the years since that project, Interstellar Studios morphed into Koenig Films and they have continued to explore a variety of topics and produce documentary films.

This month (June 2016) Koenig Films will release a new fulldome program called SEEING! A Photon’s Journey Across Space, Time, and Mind. This program has been produced for digital fulldome and is being made available free. It will screen in Brno at the IPS Full-dome Festival and shortly after will be made available for download to anyone with an interest in sharing the topic of sight in their planetarium.

The program is produced by Koenig Films and Mirage 3D. It follows a photon’s creation and journey across the galaxy to a young stargazer’s eye. Viewers then follow the photon into the girl’s eye, learning the structures of the eye and their functions, prior to taking a ride on the optic nerve. SEEING! A Photon’s Journey Across Space, Time, and Mind was written by Emmy Award-winning writer Kris Koenig, directed by Robin Sip, and narrated by Neil deGrasse Tyson, director of the Hayden Planetarium in New York City.

The program uses hemispheric 2D and 3D animations and video to teach how human vision works. Imagery from numerous places around the globe, featuring humanity, landscapes, skyscapes, and wildlife, will be the backdrop for photorealistic animations that create the story of a photon’s journey through the eye and its conversion to an electrochemical impulse that then travels the neuro pathways of the brain to the various centers that create the image the brain sees.

Viewers also explore a variety of conditions which affect sight and new technologies used to overcome the problems they cause.

A documentary as well

Similar to the project in 2009, a one-hour documentary on sight and vision called SIGHT: The Story of Vision is part of a set of multimedia products, including a website, mobile app, e-book, and public outreach events that will be presented by associated public television stations across the US.

The domestic and international broadcast premiere on World Sight Day on October 13, 2016. SIGHT will provide the public with an understanding of the science, medicine, and technology that allow us to see, while increasing the viewer’s appreciation for their own sight.

The story includes threads on worldwide vision crisis and the people who battle to eradicate blindness. Music legend Sir Elton John narrates the documentary. SIGHT has been underwritten by several major vision industry players, among them ZEISS, Luxottica, VSP, Alcon Foundation, and the Brien Holden Institute Foundation.

More information on SIGHT and SEEING!, including trailers, is available at storyofsight.com or on Facebook at www.facebook.com/eyedocumentary.

—Shawn Laatsch
DINOSAURS @ DUSK
the origins of flight

Also available in 3D

Watch the full-length fulldome film at www.mirage3d.eu

For licensing please contact Robin Sip: rsip@mirage3d.nl
Asteroid Day and the International Planetarium Society have joined forces. Asteroid Day is an annual global awareness campaign that allows people from around the world to come together to learn about asteroids and what we can do to protect our planet, families, communities, and future generations from asteroid impacts. The International Planetarium Society is in partnership with Asteroid Day to support this worldwide public education effort about asteroids and the associated science and scientists working in the field.

The Beginnings

In February 2014, Dr. Brian May, astrophysicist and famed guitarist for the rock band Queen, began working with Grigorij Richters, the director of a new film titled 51 Degrees North, a fictional story of an asteroid impact on London and the resulting human condition. May composed the music for the film and suggested that Richters preview it at Starmus, an event organized by Dr. Garik Israeli and attended by esteemed astrophysicists, scientists, and artists, including Dr. Stephen Hawking, Richard Dawkins, and Rick Wakeman—plus planetarians like Thomas Kraupe. The result was the beginning of discussions that would lead to the launch of Asteroid Day in 2015.

To ensure that the movement had global support, Dr. May then introduced Richters to the B612 Foundation, an American-based non-profit advocacy organization created to protect the world from dangerous asteroids through early detection.

From B612, Apollo 9 Astronaut Rusty Schweickart, three-time Astronaut Dr. Ed Lu, and Chief Operation Officer Danica Remy, brought to Asteroid Day a network of planetary defense specialists and global contacts. Soon joining May as advisors to

1 B612, headquartered in Mill Valley, California, was formed in 2002 by Dr. Clark Chapman, Dr. Piet Hut, Dr. Ed Lu, and Rusty Schweickart. Learn more at b612foundation.org.

Asteroid Day were Schweickart, Lu, and Remy, as well as Lord Martin Rees, Astronomer Royal of the UK; musical artist Peter Gabriel; and other planetary defense experts.

In all, there are 4 co-founders for Asteroid Day: May, Richters, Schweickart, and Remy.

Richters' next move was to engage Dr. Mark Boslough, a well-respected asteroid scientist, to join Rusty Schweickart in organizing the Asteroid Day Expert Panel, and Dave Eicher, editor of Astronomy magazine, who became the editor-in-chief of the day. Through ensuing conversations with all players, the concept for a day dedicated to asteroid awareness around the globe was born. Now to “make it happen.”

The 100X Declaration

Part of Asteroid Day is the 100X Declaration, which calls for three actions:

- Use available technology to detect and track near-Earth asteroids by both governments and private organizations;
- Accelerate the asteroid discovery rate to 100,000 per year within the next 10 years; and
- Adopt globally Asteroid Day on June 30.

The date of June 30 was selected because it is the anniversary of the largest impact in recent history, the 1908 Tunguska event in Siberia.
"The more we learn about asteroid impacts, the clearer it became that the human race has been living on borrowed time," remarked May. "Asteroid Day and the 100X Declaration are ways for the public to contribute to an awareness of the Earth’s vulnerability and the realization that Asteroids hit Earth all the time. Asteroid Day would be the vehicle to garner public support to increase our knowledge of when asteroids might strike and how we can protect ourselves."

“Early warning is the essential ingredient of planetary defense,” said Schweickart. “Time is the issue. At the current rate of discovery of 20-meter NEOs and larger at about 1,000 per year, it will take more than 1,000 years to find one million NEOs that potentially threaten Earth. That’s a long time and even then we’d have reached only 10% or so of the Chelyabinsk-size objects that potentially threaten impact.”

A press conference to announce the launch of Asteroid Day was held simultaneously in London and San Francisco on December 3, 2014. Representing Asteroid Day in London were Richters, May, and Rees, and in San Francisco, Schweickart, Lu, and Astronaut Tom Jones, president of the Association of Space Explorers (ASE). Lord Martin Rees read the 100X Declaration, and the list of signatories for the declaration rapidly grew to include hundreds of esteemed scientists, physicists, astronauts, and Nobel Laureates from 30 countries and leaders in business and the arts.

Original signers include Anousheh Ansari, Stewart Brand, Brian Cox, Richard Dawkins, Alan Eustace, Peter Gabriel, Steve Jurvetson, Jane Luu, Dr. Brian May, Greg McAdoo, Peter Norvig, Helen Sharman, Jill Tarter, Kip Thorne, and more than 38 astronauts and cosmonauts.

To date, the 100X Declaration has been signed by more than 17,000 private citizens.

For a full listing of notable signatories, visit www.asteroidday.org/signatories-list.

What began as a scientifically-based declaration about the need for rapid discovery of asteroids to ensure the defense of our planet grew to a global movement of awareness regarding this solvable nature-caused problem that included more than 150 self-organized events around the globe.

**You and Asteroid Day**

Last year’s global response was outstanding and Asteroid Day 2016 is anticipated to be even greater, also because Asteroid Day and IPS are now joining forces. This article is the first of many more to come: articles to be published back and forth between websites, newsletters, and other vehicles as appropriate. At each others’ respective conferences and events, both organizations will work on appropriate joint formats and—most importantly—will engage in ongoing conversations about best practices in education and public relations.

This year’s goal for Asteroid Day is to reach 300 events worldwide, in hope of spreading global awareness and scientific knowledge. To assist in reaching this goal, AD and IPS is reaching out to members and local communities and encouraging them to coordinate self-organized Asteroid Day activities, on/around June 30, 2016.

Although the event is promoted on June 30, we encourage everyone to host activities all year long. If interested in self-organizing an event in your area, Asteroid Day is providing the educational tools and resources, alongside an event organizers guide, to assist in kick starting your event.

A notable resource Asteroid Day offers is the ability to submit a request to have an astronaut attend your event, foreseeing that your organization is able to cover travel costs or if one is local in your area and available. Event organizers will also get free access to an 8-minute planetarium show produced by the European Space Agency, one of Asteroid Day’s major partners. This production will be made available in German, English, Spanish, Italian and French.

Furthermore, event organizers will have access to signatory videos and the feature film S1 Degrees North to screen at their event.

We would also like to mention that Discovery Science, another Asteroid Day major partner, will run an 11-day-long campaign around the world and is interested in partnering with local planetariums. To submit any requests, contact the Asteroid Day event communications manager, Jennifer Arriaga at jennifer@asteroidday.org or if you have any other questions.

For more information and details about Asteroid Day, visit: asteroidday.org

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2 The ASE was founded by Schweickart.
In 1979, the Soviet Union’s fleet of space communication ships numbered 11. They were created to allow for tracking of lunar and deep-space missions, and also as a relay for cosmonauts to communicate with mission control. Vessels built under the lunar program experienced triumph and tragedy during their lifetimes, the final blow arriving in the early 1990s in the form of the economic crisis.

Of all the ships, only Cosmonaut Viktor Patsaev continues to live and work today and is an important part of the living history of astronautics. The vessel, originally named the Semen Kosinov and built of timber, was converted in 1978 to communicate with spacecraft. Until 1994, under the pennant of the USSR Academy of Sciences, the research vessel was part of the command and measuring complex for satellite and mission control and interplanetary stations for receiving and processing information.

Over the course of 15 years the Patsaev took part in 14 flights, studying telemetry and providing a link to mission control for the orbiting Salyut-6 and Salyut-7 stations, Mir, the spacecraft Soyuz and Progress, and reusable system “Energia-Buran.”

The orphaned ship
After completing the last mission in 1994, during the difficult economic time for Russia, the ship became an orphan, claimed by no agency. In 2000, a decision of the Russian Aerospace Agency allowed the Cosmonaut Viktor Patsaev to be relocated to Kaliningrad. In 2001 it was moored at the museum quay, a move that saved the ship from the bitter fate of the others, most of which were sold for scrap metal.

In 2009, there were difficulties with obtaining grants for the preservation and operation of the ship. The question arose whether the write-off and sale of the ship would follow, suffering the fate of Cosmonaut Georgi Dobrovolskiy, which was sold for scrap for 24 million Rubles in 2005.

The question of the preservation of the vessel was discussed twice in 2010 and 2013 at meetings of the Marine Board of the Government of the Russian Federation. On the Order of Service of the state protection of cultural heritage of the Kaliningrad region on July 24, 2015, the Cosmonaut Viktor Patsaev was included in the list of identified sites of cultural heritage, subject to state protection.

Now it is the only ship in the world of space communications with an on-board museum exposition; the exposition occupies more than 500 square meters. Some rooms are remodeled; laboratories with outdated equipment are used. By the end of 2015, the exposition will include over 600 exhibits, numerous historical documents, and works of art. The exposition is open from 11:00 to 19:00. The opening address will be given by the Space Museum Director Irina Khabidova.

The comships of the Soviet star flotilla
Cosmonaut Vladimir Komarov
Cosmonaut Yuri Gagarin (flagship)
Academik Sergei Korolev
Cosmonaut Pavel Belyayev
Cosmonaut Vladimir Volkov
Cosmonaut Georgi Dobrovolskiy
Cosmonaut Viktor Patsaev
Academik Nikolai Pilyugin
Krasnodar
Illichevsk
Dolinsk

Four of ships commemorate cosmonauts who died during missions. Vladimir Komarov was killed when his reentry parachute failed to open and his Soyuz I capsule hit the ground at high speed in 1967.

Georgi Dobrovolski, Viktor Patsayev, and Vladislav Volkov, the crew of Soyuz II, perished in 1971 when a cabin valve accident allowed their crew capsule to depressurize and they suffocated.

They had successfully docked with the Salyut 1 and were on their way back to Earth. Their deaths were the first, and hopefully only, to have occurred while officially in space.

The other cosmonauts honored were Yuri Gagarin, the first human in space in 1961; Pavel Belyayev, first commander of the cosmonaut corps and also commander of the Voskhod 2 mission in 1955, the first spacewalk.

Sergei Korolev was the man considered by many to be the father of practical astronautics, and Nikolay Pilyugin was the chief designer of rocket guidance systems.
Featuring David Bowie’s Space Oddity

THE SECRETS OF GRAVITY
IN THE FOOTSTEPS OF ALBERT EINSTEIN

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SOFTMACHINE
www.softmachine360.com
Glasgow Science Centre has just installed Scotland’s first fulldome digital planetarium, upgrading its facilities from an optical-mechanical projection system to a digital display system. Due to open on 5 September, the planetarium will seat 115 and will feature the technology to visualise real-time scientific data and satellite imaging, along with showing fulldome films, allowing its visitors to see our universe in a 360° immersive theatre setting.

At the heart of the new Colorspace theater system, designed and commissioned by Swedish fulldome company Sciss, are two JVC 4K projectors. These projectors are seamlessly blended for extremely high visual quality, offering a total resolution of approximately 4000 active pixels across the meridian. The digital planetarium is powered by Sciss’s Uniview 2.0 software and high performance servers, also designed by Sciss. This fulldome software allows for the audience to fly through space visualizations, all based on real scientific data gathered by telescopes and observatories around the world. The planetarium will be capable of travelling through our solar system and our planetarium, allowing visitors to observe the night sky from any location on Earth, visit the surface of the Moon and Mars, and much more.

“The new digital system will allow our visitors to explore the universe like never before, through live presenter-led shows taking them on a tour through our solar system, or zooming out of the Milky Way to seeing our galaxy from above,” said Astronomer and Planetarium Manager Steve Owens.

“We will take seconds to transport our audiences to places in space that would take the fastest spacecraft ever built 40,000 years to reach and we will have shows suitable for all ages, allowing us to engage with pre-school children, school pupils at all stages of learning, and families, while at the same time enabling us to take our adult learners on in-depth explorations of our cosmos in a programme of evening lectures and night classes.”

Cosmonauts (from left) Vladislav Volkov, Gregori Dobrovolski, and Viktor Patsayev

(Viktor Patsayev, continued from page 30) equipment were turned into exhibition halls and the gymnasium became a planetarium with interactive exhibits. (See a photo of the planetarium on page 72, part of International News.)

In April 2001, the year of the 40th anniversary of the flight of Yuri Gagarin, twice Hero of the Soviet Union Cosmonaut Alexei Leonov opened on board the exhibition called “A Space Odyssey.” All these years, Leonov is the curator of the exhibition.

Teachers from the Immanuel Kant Baltic Federal University in Kalingrad give lectures and practical exercises with students at the telescopes. Students of educational institutions are trained in the pilothouse, engine room, and educational laboratories.

Especially of great interest is the tour of the laboratories on the vessel, especially the space communication aspects: the command post, the wheelhouse, laboratories, and observation platform with a telemetry antenna. Weekly demonstration sessions are held with the International Space Station, which involves a set of antennas and hundreds of guests who are able to hear the voices of the astronauts.

In 2005, NASA handed over the operational control of the ISS to Russia when the Johnson Space Center was evacuated for Hurricane Rita. The Cosmonaut Viktor Patsayev was put into service as part of the backup mission control.

The World Ocean Museum receives about 400,000 visitors a year, much of it accounted for by the ship visits. Over the years, visitors have been met with 12 exhibitions and expositions on board.

Cosmonaut Viktor Patsayev is managed by the Joint Stock Company Scientific and Production Association of Measuring Equipment, which performs the tasks of management of the Russian segment of the International Space Station under the Federal Space Programme.

Irina Habidova, an expert on exposition and exhibition activity, has worked with the Museum of the World Ocean since 1998, and has been curator of the museum’s activities aboard the Cosmonaut Viktor Patsayev since 2001. She is the author of 12 exhibitions and expositions on the ship with themes that include the history of the USSR marine fleet of space, research vessels, and Cosmonaut Victor Patsayev.
NARRATED BY LIAM NEESON

DYNAMIC EARTH
Exploring Earth’s Climate Engine

Public Choice Award
Short Film
Espoznica Immersive Film Festival 2011

Golden Star Award
South Korea
Planetarium Fest 2012

Award Winner
Maine Brightstar
Jena FullDome Festival 2011

Finalist
Julian Hale
Science Media Awards 2012

Contact: Mike Bruno 
mbruno@spitzinc.com 
T: 610.459.5700
The modern digital planetarium is a powerful data visualization facility. Planetarium software lets you smoothly explore a tremendous array of datasets spanning an incredible range of physical scales, from high resolution maps of Mars to our deepest galaxy surveys. All of which, when used correctly, has great potential to amaze, inform, and most importantly, inspire the planetarium going public.

Still the opportunity is there to do much, much more. At the core of realizing that potential is a philosophic shift in the role of the planetarian, from that of a curator of astronomical data to that of an “astronomical weatherperson,” interpreter of the continuous flow of information coming from telescopes, space missions, and computer simulations.

Hopefully this will also inspire a shift in how the public views the planetarium, from a place to be visited once in a lifetime or once a new show is released, to a place that one should visit frequently to keep abreast of our growing understanding of our place in the universe.

Data to dome

To realize this vision we need to streamline the entire process of identifying and acquiring a scientific dataset to visualizing it in the dome. We need to stop thinking of data as relics that are stored in modules and collected in repositories, and instead start treating data as a dynamic entity that flows in streams to be tapped into.

Fortunately there is an open data revolution taking place the sciences, one that in large part is being led by the astronomical community. To take full advantage of this revolution, the planetarium needs to learn to feed closer to the source. That means understanding scientific data formats and integrating with the application program interfaces that allow for a direct connection to the major scientific databases.

Right now the typical process we follow when we want to visualize a new dataset in the planetarium is something like:

- Figure out where we can get the data from.
- Write a program to read in the data.
- Perform coordinate transformations and reprojections.
- Write out the data files that the planetarium software can understand.
- Load the data module into the planetarium software package.

In the future, all these steps should go away. The software should know when new data becomes available, know how to pull it directly from its source and know how to interpret and visualize it. The result of this transformation will mean that whole rich spectrum of scientific data will be available in our planetariums. And they will be available faster; when a press release comes out in the morning, we should be able to display it in the planetarium that afternoon.

Big data

The big data era is upon us. The first data release from the Gaia satellite is happening this year. The Large Synoptic Survey Telescope will collect over 30 terabytes each night for ten years. Photo: LSST Project Office.

The strategy is to only take what you need to form the image. The same type of strategy that allows us to smoothly zoom into maps on our phones can be put to work to visualize data from Gaia, LSST, or the latest computational simulations.

To be fair, going from 2D to 3D (or 4D) adds significant complexity. Solving this problem is the most critical challenge facing the next-generation planetarium software. As an example, check out the Halo World web app (darksky.slac.stanford.edu/halo_world.html), which visualizes data from the Dark Sky simulation in 3D. It accesses data from a single 32-terabyte file and streams it to your browser in real time.

Big data requires big screens to visualize. The combination of large solid angle and high resolution make the modern digital planetarium the ultimate big data visualization facility. All of the pixels of the crop of 8K planetariums will be exploited by the datasets coming from Gaia and LSST.

Data visualization

We have the opportunity to elevate science communication, telling more sophisticated stories by using these large datasets. To do so effectively requires a scientific approach to how a visualization is constructed and incorporating what is known of human perception.

For example, the classic result of Cleveland and McGill shows that...
people perceive position more accurately than length, and length more accurately than area, and quantities such as color saturation quite inaccurately. The use of color brings up a whole range of issues. The misleading rainbow color map is still overused (read Borland and Taylor for details) and abused in science. Perhaps most important, when crafting visualizations for the public, is understanding the meaning people tend to attach to color (for example, red is hot and blue is cold in contrast to their physical reality, see the Astronomy and Aesthetics study for details; astroart.cfa.harvard.edu).

**Data exploration**

To recap, the data savvy planetarium will be more tightly linked to scientific data streams, intelligent in how it parses huge datasets, and better informed in how to best reveal structure through the visualization. Once this is accomplished we will have created truly world class visualization facilities that would be the envy of any university or research laboratory; facilities that are not only used for data visualization and presentation, but also for data exploration, interrogation, and discovery. Add domecasting capabilities into the mix and you have a unique platform for large group, remote, scientific collaboration.

Unfortunately, the scientific community (even the professional astronomical community) is vastly unaware of the power and opportunities currently available in the modern digital planetarium. At worst, they view the planetarium as hopelessly outdated; at best, they view it as a wonderful tool for inspiring young people and the general public to take an interest in science. Few see it for what it is, a world-class powerful and flexible data visualization tool.

How can we correct this perception? I think it up to all of us in the planetarium community. Invite local scientists in to your domes let them see their data on the big screen. You’ll be rewarded with new visualizations attached to local, personal stories. The planetarium community will be rewarded as well because word will get out about the amazing facilities that we have created.

**References**


NOTE: This article originally appeared in the SCISS blog (sciss.se/blog/mark-subbarao-the-data-savvy-planetarium); posted 2016-02-04.

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**Long-term licenses for...**

**FULLDOME Shows**

**And short-term rentals...**
As I write this, registration for LIPS (Live Interactive Planetarium Symposium) 2016 has just opened. LIPS 2016 will be hosted by Spitz, Inc. in Chadds Ford, Pennsylvania from August 10-12. Thank you to Spitz for hosting!

With LIPS 2016 rapidly approaching, I’d like to discuss LIPS’ origins. The first LIPS sprang from my frustration with planetarium conferences. I spent many years doing live, interactive shows for Pacific Science Center (PSC) in both a Starlab and a fixed dome. In fact, I have never presented a prerecorded show for the public or school groups (though I do sometimes weave in short videos).

I never attended a planetarium conference during my PSC years, but I started doing so in 2004 as a vendor. I know that good live shows require effort and practice, and I expected sessions on live programming. Instead I found little time for live shows and a lot of time spent watching fulldome movies or trailers. I’m not saying there should no prerecorded content shown at conferences, simply that there should be a balance.

Giving it a try

In the fall of 2010, I discussed the idea of LIPS with my partner and Digitalis co-founder Rob Spearman. Rob agreed that we should try it, and we started planning and organizing.

Everything came together, and the first LIPS took place at Digitalis’s headquarters in Bremerton, Washington in 2011. We had about 40 enthusiastic planetarians from five different countries. Our 6.1-m dome, the Pacific Planetarium, was used for dome sessions. We converted our hands-on exhibit area (used during Pacific Planetarium public events) to a temporary classroom space.

While I can’t say that everything went perfectly, LIPS 2011 was successful enough that the attendees voted to do it again. Subsequent LIPS have been hosted by:

- 2012: University of Notre Dame, South Bend, Indiana
- 2013: Seminole State College, Sanford, Florida
- 2014: Mystic Seaport, Mystic, Connecticut
- 2015: California Academy of Sciences, San Francisco, California

What makes LIPS different?

All sessions—including vendor presentations—are expected to be live and interactive.

LIPS is egalitarian, with only one level of sponsorship available. All sponsors receive a 30-minute presentation slot, and there is no vendor hall. Sponsors are encouraged to attend and even lead sessions. Susan Button comments, “Having vendors attend as participants and presenters helps them and us grow to see how the evolving technologies can be fully utilized to enhance our interactive programs.”

LIPS is populist. Registered attendees propose and vote on sessions. While we have not had to use votes yet, sessions with the fewest votes can be dropped in order to fit in the most popular topics. We have a group discussion near the end of each LIPS to review the current symposium and discuss the future.

There is no steering committee or governing board. Although I do take the lead, key decisions are made as a group. LIPS is not so much an organization as a movement.

LIPS days are relatively short. We start around 9am and end around 6pm. This allows time for group dinners, reflection, and even some relaxation. Breaks are typically 30 minutes, enabling schedule corrections and extra discussion.

Feedback from attendees

I’d like to also share comments from people who have attended LIPS.

From Amy Truksa, the College of Idaho’s Whittenberger Planetarium:

As the director of a strictly analog planetarium, I was discouraged from attending IPS and other conferences where I felt the cost of the trip and conference would far exceed the benefit and applicability in my dome.

I worked alone for many years in the planetarium with no mentors and quite ignorant of the resources and opportunities available to me ... When the first LIPS was offered nearby in Washington state, it seemed a perfect and affordable opportunity for me. I was not disappointed and, in fact, gained so much more from the experience than I expected.

Despite having attended only two LIPS to date, I am now part of a community of professionals. As a result of my participation in LIPS I feel more professional, I have more self-confidence about the types of shows I present, I have a group of people I can reach out to with questions, and I think more broadly about the possibilities within the dome and with the groups that visit.

Specifically, I have had the confidence to apply for a grant and received funding to present a workshop to elementary teachers to help them teach astronomy in their classrooms. I want to attend
more LIPS to work on ways to add variety to my programs, find new ways of teaching astronomy concepts, and to engage audiences (groups of small children) who are not necessarily in the planetarium to learn astronomy.

From Alan Gould, the Lawrence Hall of Science at University of California Berkeley:
When I went to the first LIPS, 2011 in Bremerton, I was thrilled to be part of an enthusiastic group of people who were all striving to achieve goals of audience participation in planetariums that we had been developing and practicing for years at Lawrence Hall of Science, beginning with Alan Friedman and Dennis Schatz in 1973.

The essential idea of audience participation does not waver with the advent of ever advancing technologies. Those technologies are easily made to serve needs of live interactive programs. Acceptance of the goals and ideas has had its ups and downs over the years, but with the advent of LIPS, and especially with Karrie Berglund’s leadership, we are on a steadily upward path.

My own session at the 2011 LIPS was all about asking questions: planetarians asking questions and audience asking questions. It was a mini workshop based on The Planetarium Educator’s Workshop Guide, Module 5 (www.planetarium-activities.org/planetarium-educators-workshop-guide#ques). Overall I remember every session at that meeting being highly interactive and as such, perfect for us all to learn new tricks and techniques.

From Ian McLennan, Ian McLennan Consulting:
As one of the people responsible for inflicting the era of the pre-recorded planetarium show on both our profession and the general public, I sometimes feel like I have a lot to answer for. The original idea of establishing quality control over presentations was a defensible one—and in the pre-IMAX era, there were compelling arguments for recorded planetarium shows. These allowed us to pay close attention to sophisticated production details, timing, dissemination of correct information—and consistent quality control.

But the pendulum, arguably, has swung too far, and now many planetariums routinely present “push-button” shows that are indistinguishable from other kinds of canned productions—including better-financed IMAX films.

The LIPS movement has focused overdue attention on the topic of live presentations in planetarium environments—which promise to re-establish the magic and distinctiveness of the planetarium medium. Live presentations allow for increased attention to topical or current events, as well as the immediate needs and dynamics of a particular audience. All of this requires professional and skill development—and that, indeed, has been a central focus of LIPS and its eager adherents and participants.

I have attended most of the LIPS conferences—and count them as the most engaging, most interesting, most fun and most worthwhile of all the professional meetings I attend each year.

From Mark Webb, Adler Planetarium:
We currently have a live component to more than 90% of our public programs, that’s approximately 5,000 live, or combination live and recorded, shows per year. I know that our shows have benefited tremendously from the lessons of audience engagement that I have experienced at LIPS. Our visitors now get to be involved with the program on a personal level which is an experience that we rarely get from a canned presentation. This transformation doesn’t magically happen every time you substitute a live presenter for recorded narration; it requires work and skill to learn how to coax the audience into a different mindspace. But the effort has been worth it!

LIPS has consistently attracted a group of people who care enough about interaction with the audience that they make the effort to attend a gathering focused on the topic, often foregoing other more traditional planetarium conferences to do so. The LIPS attendees have never failed to inspire me to further humanize what we do under the dome. To me, it seems like the days of bringing in the anonymous audience and presenting a pre-recorded show are something from the distant past. I can’t think of a single positive reason for reverting to it.

My participation in LIPS has kept me focused on truly putting the needs of the audience first.

From Susan Button of Quarks to Clusters:
I was lucky enough to be in attendance at the first LIPS in 2011. With the advent of digital planetariums came a sharp decrease in emphasis of live interactive programs in many planetariums. Many portable planetarium directors began showing movies and did not realize how powerful these new tools could be if used to enhance rather than replace live programming; the educators among us were certainly dismayed at this trend.

(Continues on page 38)
Two young enthusiastic members of our community, one an educator and one a technical expert, saw a need and kick started a revival movement in favor of live interactive programming in planetariums. They had an incredible response to their efforts in August 2011 at the first of many future get-togethers. People from a variety of states and countries joined to share their dedication of sustaining all generations of planetarians who want to blend the best content, using any and all of the various technologies, with superior and imaginative presentation techniques.

I try to attend as many LIPS events as I can because the atmosphere feeds my soul and spirit as an educator and as a champion for portable planetariums. But these meetings are not just for mobile domes, it is fantastic to see how many stationary dome directors also attend; they find the same support, inspiration and knowledge that is so vital to their jobs.

Each meeting is unique; the focus topics change as members contribute their own special talents. Invited experts guide participants through a variety of team building and theater improv exercises. These experiences help us to tap into our inner creative child and guide us to hone our skills and make us better live performers in our domes.

From Karen Klamczynski, Evans & Sutherland:

For decades, planetariums have presented both “canned” and live shows. Lots of planetariums found live star shows so popular that they weaved some form of live presentation into every show, even if it was just a five-minute “what’s up” before the recorded show. Modern digital planetarium software has features we considered pipe dreams fifteen years ago; today, many planetarians have astounding capabilities at their fingertips. Perhaps it was unexpected to see some of these powerful systems, suddenly capable of creating a multimedia star show on the fly, used to load and play video shows. On the other hand, to be fair, the production quality of “canned” shows increased dramatically, and those shows have proven themselves valuable.

LIPS shines a spotlight on the importance and tradition of live, interactive shows and hopefully inspires planetarians to realize the full potential of their domes.

I was excited to attend the second LIPS conference in 2012. Live shows have been very important to me since the very beginning of my planetarium career. The conference presentations ranged from no-tech to high-tech, and each inspired creativity and ideas. I'm always interested in how various interaction techniques can scale up or down with audience size, and I found LIPS a great place to engage in such discussions.

Thank you to everyone who sent in comments and photos! Together we make the LIPS movement as strong and vibrant as it is.

For those of you considering attending or sponsoring LIPS2016, act fast! Registration is limited to 45 non-sponsor attendees and 10 sponsor companies. Visit LIPSymposium.org to register or to learn more.

You're invited to take part

Solstice 2016 will be a multi-stream, twenty-four-hour event, covering all of Earth's time zones. Participants will perform their Solstice art in whatever medium they choose, between the hours of 17:00 and 18:00 in their time zone, or create the performance in advance.

Viewers around the world will be able to catch individual or simultaneous feeds of the various performances throughout the Solstice period, and add their thoughts to the Comment Stream.

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As we look forward to the IPS 2016 conference “Revolve” in Warsaw, I think it is relevant to examine the nature of the paradigm change from geocentric to heliocentric solar system that was initiated with the publication of *de Revolutionibus orbium coelestium* in 1543 by Copernicus.

Many of us teach some history of astronomy. We highlight the Copernican Revolution in our classes and in our planetarium presentations. The Copernican Revolution is significant not only for its particular content change, but also as an outstanding illustration of a paradigm shift. A well-rounded education includes understanding of historical changes in our ways of thinking. After telling the story of the Copernican Revolution, I will suggest some ways we might introduce it to older students and planetarium audiences.

**Some early heliocentric ideas**

Although today they rarely get credit, some early philosophers and mathematicians also had heliocentric ideas. Philolaus (c. 480-385 BCE) described a “central fire” at the center of the universe with other bodies revolving about it. Heraclides Ponticus (387-312 BCE) suggested that Earth rotates. Aristarchus of Samos (c. 310-230 BCE) first declared that the Earth revolves about the sun, as recorded by Archimedes in his book *The Sand Reckoner*. Seleucus of Selucia developed mathematical details of Aristarchus’ heliocentric system (c. 150 BCE).

Arabic astronomers also offered ideas that resembled those put forth by Copernicus. Aryabhatiya (499) said that the Earth rotates on an axis. Najmi al-Din al-Qazwini al-Katibi (c. 1277) at the Maragha Observatory proposed a heliocentric model, but later abandoned it.

Within the total intellectual community, heliocentric ideas rarely were mentioned or debated before Copernicus. The geocentric system of the universe published in Ptolemy’s *Almagest* (c. 1560 BCE) and ideas of Aristotle were the prevailing astronomy and physics paradigms in Europe throughout the Middle Ages, including during Copernicus’ life.

The Ptolemaic-Aristotelian system had become thoroughly entwined with Christian religion, with both Catholics and Protestants believing that God had made Earth the center of creation. To argue contrary to Ptolemy and Aristotle was blasphemy. Arguments for Ptolemy and Aristotle were backed by literal statements from the Bible.

**A man of many talents**

Copernicus was a man of many talents—a theologian, mathematician, astronomer, doctor, administrator, economist, and humanist—and he moved in intellectual circles and studied many subjects in both Northern Europe and Italy. He was very aware of accepted theories, including those of Ptolemy. As Copernicus began to develop his heliocentric theory when he was about 30 years old (1501-1503), it seems clear that he was hesitant to “rock the boat.” As secretary for his uncle Watzenrode the Younger, a Prince-Bishop, as well as a recipient of a doctorate in canon law and a religious administrator throughout his life, Copernicus understood how promotion of the heliocentric theory would destroy his career.

Copernicus was an avid astronomical observer, and he continued to pile up observational data (prior to use of the astronomical telescope) which he believed supported the heliocentric theory. He read widely, including ancient Greek ideas. He knew of Aristarchus and gave credit to him in early writing. His *Commentaries*, written sometime before 1514 and distributed to just a few friends, was a forerunner of his planned book—the extensive 6-part *de Revolutionibus* eventually published at the time of his death in 1543.

When Copernicus was 60 years old, in 1533, Pope Clement VII and other cardinals showed positive interest when Copernicus’ friend Johann Widmannstetter gave a series of lectures in Rome outlining Copernicus’ theory. The book *de Revolutionibus* probably was finished, and word about it was spreading among intellectuals throughout Europe.

Criticism did not come from the pope, but Copernicus knew how the published book would be received by some.

Over half a century later, when Galileo Galilei looked through his telescope, he was convinced that the heliocentric system was correct. With great enthusiasm and often with lack of tact and thoughts of retribution, Galileo promoted the heliocentric theory. In his Italian-language *Dialogue Concerning the Two Chief World Systems* (1632), Galileo made the mistake of putting ideas of the pope into his character of Simplicio, eventually bringing down the full weight of the Inquisition and putting him under house arrest for the remainder of his life.

In spite of Galileo’s great contributions to science, it seems he greatly damaged the image of the heliocentric theory and kept science away from it for many years to come. Books by Copernicus, Galileo, Kepler, and others were removed by the Catholic Church from an accepted reading list from 1616 to 1758.

Galileo saw three important things with his telescope that made European thinkers take notice: moons revolving about another Jupiter, the sun with spots instead of being a pure and uniform creation, and phases of Venus. All of these eroded the religious connection to Ptolemy.

In his recent book *The Invention of Science*, David Wootton points out that when Christopher Columbus reached America in 1492, the
discovery demonstrated that Ptolemy’s grasp of geography was flawed. Thus another door was opened to question Ptolemy and serious consideration of the heliocentric theory.

**Today’s system differs**

The heliocentric system of the solar system we currently accept is different from the system of Copernicus. Copernicus had one foot in the Middle Ages because he insisted on only circles for orbits. Therefore, like Ptolemy, to match observation and theory, Copernicus had to include a few epicycles and deferents in his system. Both Ptolemy and Copernicus believed the solar system was encased in a crystalline sphere. Thomas Digges (1576) and Giordano Bruno (1593) later added the concept of infinite space.

Soon after publication of *de Revolutionibus*, its included tables were accepted and used, but beyond offering greater simplicity than Ptolemy, there was no observation that showed that the heliocentric system was right. Even the telescopic observation of Venus’ phases proved only that Venus goes around the sun. Venus’ phases did not rule out a third theory of the solar system suggested by astronomer Tycho Brahe in the late 1570’s. (At least three others had also suggested such a system: Martianus Capella (410-420), Johannes Scotus Eriugena (815-897), and the Indian astronomer Nilakantha Simaya (1444-1544).

In the Tychonic System, the sun revolves about Earth, while Venus revolves about the Sun. Tycho’s motivation for developing his theory was that he could not observe stellar parallax. With his system, the phases of Venus could be explained, while in Ptolemy’s system they could not. Tycho clung to Aristotle with the belief that the Earth was heavy and sluggish and therefore could not move. Like Ptolemy and Copernicus, Brahe believed the Earth to be at the center of a large crystalline sphere with a boundary just beyond Saturn.

After his death, Copernicus’ ideas suffered attacks from both Catholics and Protestants. Scripture words, such as stopping the sun’s movement, were regarded as proof that his theory was wrong. Even Tycho, who usually thought scripture support was secondary to science, noted that we must infer from scripture that the Earth does not move.

Historian Owen Gingerich, who has examined every extant copy of the early publications of *de Revolutionibus*, found many marginal notes in these copies. The notes reveal the careful thought that intellectuals were giving to the Copernican theory after the book’s publication.

During the 1600’s Galileo’s work on inertia to explain how the Earth could be moving without our feeling it and Kepler’s work on elliptical orbits no doubt helped convince intellectuals that the heliocentric theory was correct. And Isaac Newton’s *Principia* (1687 with new editions in 1713 and 1726) became the cornerstone of new science that included a heliocentric solar system. That new science expanded into the social realm, where revolutions in countries that resulted in new constitutions promoting freedom were written and became law.

Some ideas have been offered to explain the great time lag between when *de Revolutionibus* was published (1543) and when it was widely accepted. In 2014, in an article in *Scientific American*, “The Case Against Copernicus,” Dennis Danielson and Christopher M. Graney wrote that it was prudent for astronomers, physicists, and other intellectuals of his time not to support Copernicus. They point out that the situation with Copernicus’ hypothesis was similar to scientists not accepting the 2011 Cern research data of neutrinos in a vacuum traveling faster than the speed of light. This, of course, is not allowed by Einstein’s theory. The data was later revealed to be faulty.

It was not until almost 200 years after *de Revolutionibus* that stellar aberration (1727), stellar parallax (1838), and the Foucault pendulum (1851) definitively proved the heliocentric theory. Foucault pendulum (Continues on page 42)
lums now are found in many large planetariums and museums, with a bob knocking down dominoes or pegs proving that the Earth moves. Personally, I think that in addition to lack of proof for the heliocentric theory in 1643, it takes time for people, even deep thinkers, to get used to new ideas. Perhaps this was true more in the past than now, with our vastly improved communication via technology. My father (Richard Emmons, 1919-2005) noted that when he studied physics in the early 1940’s at UCLA (University of California at Los Angeles), his professor sarcastically dismissed Einstein’s Special and General Theories of Relativity and would not discuss them.

Communicating the Copernican Revolution

So how might we tell this important story to others in our classes and planetarium audiences? Mathematical arguments should best be left to in-depth history of science classes, but there must be much about the Copernican Revolution that should be known by all.

I think the story is appropriate for older students and adult audiences. The subtle interplay of hypothesis, proof, personal nature, and the intellectual landscape probably cannot be understood until a person reaches a level of thinking that Piaget called “formal operations.” This brain ability stage begins for many people in their mid-teens and continues to develop throughout the teen years.

We do not have to convince most older students and adults that the Earth revolves about the sun. The geocentric misconception is held by young students who see the sun rising and setting in a way that intuitively suggests that the sun revolves around the Earth.

The observation of the sun rising and setting can be a starting point for discussing the heliocentric theory. If we begin by showing the daily path of the sun and then ask “does the sun really revolve around the Earth each day as we see it happening here?,” we may initiate understanding of resistance to the Copernican theory. By simply observing the sun’s daily path, an audience can appreciate why people clung to a geocentric theory.

Further demonstrations of the sun moving against Zodiac stars, different paths of the sun at the beginning of other seasons and at other latitudes, and the phases of Venus can then be matched with models—geocentric, heliocentric, and Tychonic—to see if each model is or is not compatible with observations.

I think a digital planetarium will be very beneficial in this process. A zoom outward can be done following Earth-based observations. The audience would identify key components of sun, Earth, Venus, and other planets as seen in a view from space. The way that positions of the sun, Earth, and other planets relate to the Earth view should be more obvious and immediate than when shown with physical models at the front of a planetarium. However, both ways of depicting the in-space view will work.

Take advantage of a Foucault pendulum if your facility has one. For my classes, I have a small model pendulum and I demonstrate the way the bob changes direction by purposely adjusting it. I tell my students that it is a model and I am duplicating the effect of Earth’s rotation. In a digital planetarium, a model of a precessing Foucault pendulum can be projected, possibly a very large one that spans the dome’s diameter.

Older students frequently give the incorrect reasons for the seasons. Consider presenting a class or program in which topics of the seasons and the Copernican Revolution/heliocentric system are combined.

Relating to STEM/STEAM

Many details of the Copernican Revolution story can be related to the array of subjects found in the educational buzzwords of STEM (science, technology, engineering, math) and STEAM (science, technology, engineering, arts, math). Geometry, technology and engineering, the instruments used by Tycho Brahe, and the astronomical telescope are integral parts of the Copernican Revolution Story.

Treating the Copernican Revolution as a story engages a class or audience. Characters can be depicted in slides or other visuals or even as real-life actors. Self-reference is a key way to focus attention, so include questions or purposeful ways to show how these people had lives and hopes and dreams and problems like audience members. Research the personalities of Copernicus, Galileo, Tycho, and Kepler.

Writing is a very important way for students to show what they have learned or how an event has affected them. After the study of the Copernican Revolution, I recommend having students write their own answers to questions such as “Why do you think people did not accept the Copernican theory in 1543 when it was published?” “Would you have published the heliocentric theory while you were alive if you had been Copernicus? Why or why not?” and (after discussing the meaning of paradigm change or shift), “Why is the Copernican Revolution a paradigm shift?” and “Do you think we are living at a time of a paradigm shift? What could it be and why?”

IPS 2016

I will be in Warsaw for the IPS 2016 conference, and I hope that many of you also will be there. I am looking forward to walking in the footsteps of Copernicus in areas of Poland. I will be thinking of the story of the Copernican Revolution as I travel.

Some resources


Nicolaus Copernicus. Wikipedia online encyclopedia. Last updated April 16, 2016. (Author Note: This is an outstanding summary of the life, work, and writings of Copernicus. As I consulted other sources, I found no inconsistencies. This is a treasure of details. It contains a large number of footnotes (145) and a lengthy list for further reading.)

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The Story of Two Domes: Our History

T. Banys and T. Kisiel, EC1 Planetarium

EC1 Planetarium occupies a unique red brick building, which is part of the EC1 Łódź, or City of Culture complex. Why the name? The site was, until year 2000, a working, nearly hundred-year old power plant, delivering electricity to factories and individual citizens inhabiting the city of Łódź, although in recent years its turbines spun only if other power plants in the city were not enough.

The entire complex—dating back to 1906—is a great example of early 20th century industrial architecture, which in Łódź usually carried a strong neo-classic flavor. The entire city—which for years has been Poland’s second largest (and only recently has been surpassed in population by Kraków)—includes dozens of palaces and post-industrial sites, owing its character to over seventeen decades of the textile industry’s constant presence that ended in the 1990s.

The complex is less than a 10-minute walk off the main street of Łódź—Piotrkowska Stewwr—that is nowadays a promenade hosting a variety of pubs, boutiques, posh restaurants, and exotic bars, as well as art galleries and underground clubs, and most certainly is a key spot for nightlife. Incidentally, the complex is also just a couple hundred meters from the Łódź Fabryczna train station.

It would have been a shame to let these sturdy walls go to waste, so back in 2005 it was decided that EC1 would be turned into a cultural and arts center. Various revitalization projects were carefully analyzed and in the end, one of them was set in motion, making use of both city and European Union funding.

Since 2007, the area slowly has becoming such a center, with an added twist: a large portion of EC1 will be a fully-fledged science center, using the existing power plant infrastructure to show the visitors how energy is produced and distributed, not only in a city grid, but also throughout the entire universe. The Planetarium has 110 seats, and since January 2016 we present seven to eight full-length shows a day (it has also been occasionally used for several special events using fulldome projection since September 2015).

“Two domes, both digital fulldome”

EC1 has many other unique aspects, one of which is that it has two domes, both with digital fulldome systems powered by Digistar 5.

The main dome, dubbed simply “the Planetarium,” is 14 meters in diameter (18 meters if you count the outside diameter); it features a Digistar 5 system with 6 Sony VPL-GT100 (4K resolution, 2000 lumen brightness and 1,000,000:1 dynamic contrast ratio). The system easily aligns and blends the individual projectors to produce a crisp, digital image and “8K” planetarium content (or, to be exact, 6.5K content, with 33 million pixels on the dome).

Creating and sharing custom shows to present current astronomical discoveries is also simple, with the use of Digistar tools such as the Show Builder and the Cloud Library. For example, with the release of Pluto images, we were able to create the first textures of Pluto and share them on the Digistar Cloud during the middle of the night for Western countries. By the time they woke up, we had made a new Pluto texture to share with real images from the New Horizons spacecraft.

We also use a single Sony VPL-FH31B (FullHD resolution, 4300 lumen brightness and 2000:1 contrast ratio) digital projectors for displaying additional content, such as presentation slides during symposia or scientific conferences. This presentation projector is creatively used for other purposes during a few of our special shows.

Like many modern planetaria, there are no ball-shaped star projectors. With the quality of the Digistar 5 system, we feel our starfield is as impressive as any planetarium in the world. Of course, the theater also includes a full-fledged Dolby 5.1 audio system, programmable lighting system, and separate control inputs. These systems are controlled on tablets, giving presenters great flexibility.

Whether it is a popular science show, a lesson for groups from local schools, a concert, or anything else, this modern system simply delivers results—which can be measured in “aahhs,” “oohs,” and “wows” that keep coming from the audience. The Planetarium has 110 seats, and since January 2016 presents seven to eight full-length shows a day (it has also been used for several special events using fulldome projection since September 2015).

“The 3D Cinema”

The other dome, dubbed “The 3D Cinema,” is 10 meters in diameter and holds our second system with 5 Barco F50 projectors (5500 lumens and 5300:1 contrast ratio) that combine their output to produce images in 4K, and optionally, with Active 3D stereo output.

This dome will be part of the EC1 Science Center and will begin its regular operation by early 2017. Its programming will be tightly integrated with the rest of Science Center’s offering.

Having both The Planetarium and The 3D Cinema run on Digistar is great because our operators all can be easily trained and feel comfortable running either system. This will be very useful once the 3D Cinema and Planetarium operate on a full schedule.

(Continues on page 56)
Cecilia Öhrner  
Marketing Director, Sciss  
Hägersten, Sweden  
cecilia.ohrner@sciss.se

In early 2016, Kennedy Space Center Visitor Complex in Titusville, Florida, operated by Delaware North1 for NASA, joined forces with planetarium company Sciss (headquartered in Sweden) to design and install a new state-of-the-art system in the center’s Astronaut Encounter Theater. The theater needed to upgrade its current display system and expand its presentation possibilities.

The solution became a Colorspace CinemaTM system by Sciss, including a new larger screen and a 3D display using a Barco Galaxy 4K23 projector. The system is powered by Sciss’s visualization software Uniview, opening up to a whole new world of astronomy visualizations.

NASA’s space telescopes

The solution also included the production of a brand new live show to be made and created in Uniview: Eyes On the Universe: NASA’s Space Telescopes. It was to be created and produced by California Academy of Sciences in San Francisco, which has an exceptionally talented team of Uniview super users.

The new show has brought a completely new flavor to the program in the Astronaut Encounter Theater and is a great example of how the competence from the planetarium world can be used outside the dome.

Below follows an interview with Zach Bosch, responsible for education content development at the complex. He tells Planetarian readers about the new show and how working with a planetarium software has made way for offering the visitors at the Astronaut Encounter Theater new educational experiences.

**How did you come up with the format of the show, and how was it created?**

This is the first show we have created and the first time we have worked with Uniview. The idea began as a show marking the anniversary of the Hubble Space Telescope, but the format of the show evolved organically over time. The more we learned about the capabilities of Uniview, the better the show became and the more it expanded.

We worked with the team from California Academy of Sciences and the experts at Sciss to create a multimedia presentation that guests of all ages enjoy.

**Can you tell us a little more about Eyes On the Universe: NASA’s Space Telescopes?**

Eyes On the Universe: NASA’s Space Telescopes provides a unique perspective on our known universe as we explore how we have come to know so much about the universe and our place in it since humans pointed the first telescope to the skies.

1 Delaware North, headquartered in Buffalo, New York, is a global food service and hospitality company. It operates the Kennedy Space Center Visitor Complex.
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For info on ordering the show, visit www.calacademy.org/licensing or contact your preferred fulldome film distributor.
Exploring immersive worlds

Planetarians are in the vanguard when it comes to operating in and creating content for immersive spaces. Of course, we’ve always called it “creating for the dome,” but in reality (both virtual and otherwise), we’ve long wrangled with the best ways to place content on and in the dome in order to teach and entertain.

That gives us a leg up on the folks in the immersive/VR/AR/360 communities who, in some cases, are just now realizing that the full-dome community exists and has important experiences relevant to their needs.

That idea formed the undercurrent of discussion at the March 16-20 IMERSA Summit, held at the Denver Museum of Nature and Science. For the 180+ attendees, this meetup was a chance to immerse themselves in topics ranging from dome show production to the creation of virtual reality worlds.

Together, we explored the creative and business sides of fulldome immersive VR, educational programs, entertainment releases, and much more. From keynote speakers’ sparking new ideas to “making of” sessions exploring the efforts of half a dozen producers behind the year’s latest fulldome releases shown at the meeting, along with papers from nearly 40 producers and artists, the Summit provided food for thought in nearly every area of immersive endeavor.

The popular Pro.Show Networking event was a relaxed and unopposed “visiting” session on Friday afternoon. Producers, artists, equipment vendors and others showcased their work. One of many highlights of the afternoon was a chance to play with various VR headsets and explore the possibilities that VR immersion holds for entertainment and education.

As always, IMERSA reached out to honor those who contribute to immersive art. This year’s lifetime achievement award, given to IMAX film producer Greg Mc Gillivray, was accepted by his son Shawn, who shared a special film tribute with attendees.

On the last day, attendees visited the gorgeous Fiske Planetarium in Boulder for a special 8K showing of Asteroid: Extreme Mission, plus other fulldome content, and a breakthrough performance of Resonances Boreales featuring concert pianist Roman Zavada. (Read more about this performance art at: sat.qc.ca/en/evenements/resonances-boreales.)

The full summit experience was, in the worlds of keynote speaker Jenny Carden (Zenka.org), “A really great balance of practice and theory and information - balance between fulldome and the new world of VR/AR. I was very impressed.”

VR takes the stage

These yearly summits bring together producers, artists, and technical wizards. In the past two years, they have also attracted the attention of producers in the growing virtual reality community. Since VR and immersive content have so much in common, IMERSA featured a special panel about Hollywood’s interest in VR. Moderated by Blaze Digital Cinema’s Paul Fraser, the panel featured members of the entertainment world’s movers and shakers in VR. It included panelists Chuck Peil (ReelFX), Devin McGinn (The VOID), Mattias Pusch (World-Viz), and Robert Coker (Super 78). Their discussion focused on the current media fascination with VR, with anecdotes about production practices and the effect that working in VR has for actors, writers, and producers. More than one panelist pointed out that the dome community has a lot to offer to VR producers. As more than one of the panelists pointed out, “You folks in the dome world have been producing immersive work for years, and we’re just getting started learning the space. We need to learn from you!”

Keynote speakers David McConville (Buckminster Fuller Institute)
and Jenny Carden emphasized both the nature of immersivity and its effects on audiences during their presentations. McCollum opened the summit with a very wide-ranging view of immersive and virtual environments in a talk called “Suspending Disbelief: Beyond the God’s-Eye View.” Her presentation summarized humanity’s attempts to use immersive works to visualize reality, with varying degrees of success throughout history.

Carden, an artist and VR producer, carried on the theme of virtual worlds in her remarks. She pointed out the differences between VR and augmented reality (AR), with particular emphasis on their use in museums and schools, as well as entertainment and fulldome production companies such as ReelFX, Super 78, and xRez.

As part of the VR/immersive interplay, several attendees brought VR units for others to experiment with, including xRez Studio and Mattias Pusch of WorldViz. For most of us it was not the first time we had experienced virtual reality sets, but the advances in technology made it a worthwhile experience again. Pusch, who has worked extensively with engineers and others who use VR in their daily work, demonstrated the ability of a virtual space where you can manipulate objects as well as a user’s perception. Once you put on that headset and switch on the program, you really are in the 21st century version of a Star Trek-style holodeck. The possibilities for this type of immersion in education and entertainment are immediately obvious.

The arts took center stage on Saturday evening with a surprise appearance of noted artist Android Jones (androidjones.com), who stopped by to create real-time 360 artwork on the Gates dome.

Data and immersion

Of course, when it comes to producing content for our shared immersive venues, both planetarians/fulldome producers and the virtual reality communities have a wealth of data and information to use. For example, several fulldome shows created in the past few years take advantage of large data sets to create scenes and teach key concepts in such topics as climate change and astronomy. Habitat Earth, shown at the summit and produced by the California Academy of Sciences’ Morrison Planetarium, used data about kelp forests and human travel around the world to create compelling visuals for the show. In past years, such shows as Dynamic Earth (Spitz Creative Media) show off the capability of large science data sets to amaze and inform.

There is great interest in the science community in getting those data sets out to the public, and there’s no reason to think that the VR/AR communities won’t be interested in using those assets in future presentations as well. The use of those sets present great opportunities—and challenges.

Keynote speaker JoAnn Kuchera-Morin, professor of media arts and technology at the University of California at Santa Barbara, focused on the challenges of using those sets in her IMERSA presentation. She and a team of researchers created the Allosphere immersive facility (www.allosphere.ucsb.edu/about.php) to study the use of these science data sets in immersive settings. Her remarks described ways of using and appropriating data sets in artistic ways to enhance human intuition and understanding. The ideas she presented resonated strongly with the fulldome and immersive practitioners in the audience familiar with the challenges in wrestling large data sets into a show!

Shows, shows, shows!

One of the unique aspects of any IMERSA Summit is the chance to see shows. IMERSA fully embraces showing the latest fulldome shows by invitation, and this year attendees were treated to more than a dozen full-length shows, short subjects, and clips. In addition, one whole session focused on fulldome works in production, highlighting upcoming releases.

This year’s offerings were:

Asteroid: Mission Extreme (Sky-Skan and National Geographic)
Celestial Clutter (COSI/Ohio State University)
Clockwork Ocean (Ralph Heinsohn, Artworks & Ocean Mind Entertainment)
Closer to the Stars (Brno Observatory and Planetarium)
Februar (Valk Productions)
Flight over Groningen (Mirage 3D)
Gravity (softmachine.de)
Habitat Earth (California Academy of Sciences/Morrison Planetarium)
Homeomorphism (OUCHHH Studios)
Life Under the Arctic Sky (Mirage3D and BTS Productions)
Origins (Borkel-Art Pro)
Relentless Beauty (Audri Phillips)
Space Next (Afterglow Studios)
SATFest2015 (from Society for Arts and Technology)
The Flower of Afterimage (Fusako Baba)
Wanna Take a Ride (Starlight Productions)
We Are Stars 3D (NSC Creative)

The beat goes on

There were many other fascinating discussions at this year’s summit, including a producer-led “Wow Moments in Fulldome” session; another producer panel on business practices; and a number of short talks on topics ranging from streaming fulldome video to creating immersive sound, effective storytelling, and immersive art.

Next year’s summit is already in planning, and will take place February 22-26, 2017 in Denver. If you haven’t been to an IMERSA Summit, why not make 2017 your chance to see what IMERSA brings to the fulldome/immersive/VR/AR table?

IMERSA at IPS 2016

For those of you attending the IPS meeting in Warsaw, the IMERSA board will present “The World of Immersion” (session 54). They will focus on the many aspects of immersion—from the Allosphere designed for spherical research to the Vortex Dome dedicated to entertainment and art, from the explosion of the VR to the evolution of business models. If you’re there, don’t miss the opportunity to hear and see what is happening in our immersive world.
It was exactly 200 years ago that Joseph Nicéphore Niépce laid the foundation of photography as we know it today. In 1816 he managed for the first time to capture the light that fell into the dark chamber of a portable pinhole camera and to visualize the resulting image with the help of light-sensitive chemicals.

At this point however, he did not yet succeed in creating a permanent image on silver chloride paper.

He then further developed his idea, which resulted in the invention of a method called heliography. This method finally enabled him to fix an image permanently, which led to the creation of the oldest known diapositive called “View from the Window at Le Gras.” Later on other photographic processes such as “daguerreotypy” were developed based on Niépce’s work.

It is exactly this original technique which is brought back to life by the project Obscurewelten, a collaboration that was created in 2008 by the media professionals Wanja Hohmeier and Rupert Kraft.

In 2014 the photo designer Franka Schimankowitz joined the team and since then has consistently contributed her ideas and skills to further develop the joint art project.

### Capture everyday life

The idea of Obscurewelten is to capture the impressions of our everyday lives and surroundings and to bring the images back to life by visualizing them on negatives that are based on paper, as opposed to using negatives on a film base. The use of these original methods and materials enables them to show their motives in an entirely new light and to give them depth and new meaning beyond the current digital iconography.

During various photo expeditions the photo artists use self-built pinhole cameras and techniques that are as old as the art of photography itself to expose their raw photo material. This enables them to create unique and fascinating pictures whose character is further emphasized through the photographic processing undertaken inside their own laboratory.

Ever since 2003 the co-founder of Obscurewelten Wanja Hohmeier has been a regular visitor to the Planetarium Hamburg, which is among the most beautiful of its kind within Europe. His passion for planetarium shows and dome projections motivated the development of a show concept suitable for the fulldome screen.

This show, created to celebrate the 200th anniversary of photography, introduces the ancient art of pinhole photography to a wider public in a new and exciting way. The project that has been facilitated and greatly helped by the support of Tetenal Europe GmbH and their Classics product line.

### A fulldome pinhole camera?

In a discussion of the project, Hamburg Planetarium Director Thomas Kraupe gave the team a surprising new challenge by suggesting to build a “fulldome pinhole camera”—and the team set out to do just that.

During several months of creative collaboration and meticulous work, the Obscurewelten team built two wooden hexagonal 360° pinhole cameras from scratch.

These cameras are specifically designed to capture panorama images that are suitable to cover large, dome-shaped surface areas.

The resulting pictures will now take the viewer to an entirely different visual world: a world shaped by brick buildings, castles, ancient ruins, and half-timbered houses, as well as newly-constructed buildings characterized by reinforced concrete and glass that are in stark contrast to the more natural surroundings.

The work and engagement with non-digital photography that uses neither lenses nor any other electronic components adds a unique and analogue perspective to the repertoire of any dome theatre and opens up entirely new horizons to curious audiences.

Thomas Kraupe seconds that idea by saying: “I salut Wanja and his colleagues for this cool project. Obscurewelten is bringing back the basic elements, the art and the respect for hands-on photography into digital domes of our time. It will expose and attract a new generation and could open their eyes for surprising new artistic perspectives on our world.”

For further information please visit our website at Obscurewelten.com.

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Examples of the non-digital challenge at left and above.
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Surviving spring exams

Spring exams generally cause a shift in the number of groups visiting the planetarium and, if you are a classroom planetarium, it could mean a couple of weeks of very strange schedules.

My experience this year was my regular classes to the planetarium had about 1/3 their normal amount of class time. This caused me to reevaluate the pacing plan for my class. I felt that while I could continue to introduce new concepts, it would be difficult to make sure that the students reached a successful depth of knowledge.

So, I switched gears and dedicated time to fortifying the students’ knowledge of concepts we had already covered or started and integrated testing strategies.

General Strategies:
• Highlight the key ideas.
• Strike out the dead wood from the question.
• Flag questions for later review that you don’t know the answers to.
• Ask for a ruler or blank paper to act as a reading guide.
• Math Exam Strategies
  • Show your work (ask for more scratch paper if you need it; there is no judgment made for needing more space).
  • Double check that your formula is copied correctly.
  • Write out a quick list of the order of operations PEMDAS (also remembered by “Please Excuse My Dear Aunt Sally,” it stands for Parentheses, Exponents, Multiplication and Division, and Addition and Subtraction) to make it easier to follow.
• Multiple Choice & Matching
  • Strike out the distracters from the answer options.
  • Most questions have 1 wrong answer, 2 possibly correct answers, and 1 correct answer.
  • Match the ones you know first and then use process of elimination.
  • Be mindful of absolute statements (all, none, never, always) as they make the question more difficult.

At the end of the day, all we can hope for is that we have provided the knowledge and the skills so that the students are ready for the exam.

Brain break
As part of the testing season I have expanded one of the students’ favorite activities: Kaleidoscopes. Previously I just had one template in Blender for the students to use to make their own kaleidoscopes. It made a simple equilateral triangle pattern that the students just changed the pattern on a disk that was repeated out.

Another couple templates that I made were for four- and five-sided kaleidoscopes. Instead of arranging the virtual mirrors at 60-degree intervals, they are arranged as a square and pentagon respectively. Students were able to add additional shapes to the field to manipulate after they showed understanding of the basic concepts.

After having the students make a few of these, one of the students brought up seeing the inside of an actual kaleidoscope and noticed the mirrors weren’t arranged at 60-degree intervals, but instead at intervals of 72-36-72 degrees. This arrangement is kind of interesting as it creates a good pattern that is based on the internal angles of a five-point star. (Note for the samples below I distorted the shape of the disk to make the pattern more apparent while leaving the colors the same.)

One of the students challenged me to create a kaleidoscope file that has the mirrors morph from three, four, five, and star arrangement with the center object remaining stationary.

Lesson plan
Summer break lessons can be a great way to help students retain information from school from year to year. I like to have the students make sundials. When they get off the bus I gather the kids and have them partner up, with each partnership getting a piece of chalk.

The pair moves to a clear part of the sidewalk and traces one of the member’s feet, and then mark with the time the location of their head. We meet up again like this before they leave (normally about 4-5 hours later) and have them stand in their foot prints and update the shadow with the current time.

The partner who just had to stand then gets the opportunity to estimate the location for the shadow at the hours between. We have a quick discussion of how the Earth revolves around the sun and they predict with where the shadows would be in the winter.
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Preparing for the Opening

Almost a year before the official opening, EC1 decided to hire a very diverse group of people for The Planetarium. Some of them are professional graphics designers with background in film and animation, game design, and fulldome animations; some are professional astronomy educators; some are professional teachers. This unique mixture of skills and talents has worked wonders. Within a very short time the team created astronomy curriculum for schools and astronomy enthusiasts. Completing all the planned shows and scripts will be an ongoing process.

At the same time, the team took up other initiatives, including the organization of several astronomy-related events. From early on, we let the local populace know about the upcoming opening. Our events—such as the observation of the solar eclipse on March 20, the Perseid meteor shower spotting on August 13, or the Martian Day on October 2 last year—were very popular and gathered hundreds, if not thousands, of people. In addition to these many events, just before opening the team was able to take part in show production training organized by Evans & Sutherland, and prepare a multitude of materials necessary for a planetarium of this size and importance.

Lights, camera and ... ACTION

For the official opening, the EC1 Planetarium team produced their very own fulldome show, *The Signal*, dealing with the possibility of extraterrestrial life in the universe. While tackling the topic from different aspects, the form of the production also paid homage to the classic science show *Sonda* that ran on Polish national TV from 1977 to 1989 and was very appreciated at the time.

The show is a mixture of fulldome materials and live actors performing on the stage at the front part of the dome. Enormous help was provided by the film school Lodz, which allowed two of its students to take part in the play/show.

The Planetarium has produced several other shorter pieces to complement its portfolio of licensed fulldome shows (of which there are over a dozen). Our talented team of designers, animators, and presenters, hard at work creating several more shows for both The Planetarium and 3D Cinema, has also produced dozens of custom scripts, several of which (including the new Pluto texture mentioned previously) have been uploaded to the Digistar Cloud and have met with very positive response from other Digistar users.

Our team is very excited to now be showing off our capabilities to visitors. We believe our unique content and creativity will keep our visitors returning again and again. If you are attending the 2016 IPS Conference in Poland, we hope you’ll taketheshorttripfrom Warsaw to visit the world-class EC1 Planetarium.

The contemplation of celestial things will make a man both speak and think more sublimely and magnificently when he descends to human affairs.

— Marcus Tullius Cicero, c. 30 BCE

spacequotations.com
sharp: adjective \(\text{\textipa{shärp}}\) 1. keen in intellect, perception; **smart**
2. clear in detail, high visual resolution, “A ‘sharp’ projected image”

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*what’s your IQ?*
Did you know you have a fulldome 360° camera in your pocket? It’s true. Today’s everyday “smart phone” is able to shoot a high resolution full 360° spherical image using a simple free app from Google. For iPhone the app is Google Street View. (Google recently renamed the app; it was formerly Google Photosphere.) For the Android platform, get Google Camera.

Note, not all Android devices have the Google Camera as the default camera. Within Google Camera, choose the photosphere camera.

It’s very simple to use. There’s no complicated stitching required because it all happens within the app. To use, it’s just a matter of pointing the phone towards the orange dot. As you move the phone and align the white circle to the orange dot, the phone takes the next photo. Once all the photos are shot, the phone stiches the photos together.

The raw photo is saved into your camera file on the phone at a 2:1 ratio. It maps to a sphere using equirectangular projection. Here’s a photo I took at Carhenge in western Nebraska. (In the path of the 2017 total eclipse, by the way!) My iPhone 5 saves it as an 8704 x 4352 jpeg image. Newer phones will save at a higher resolution.

Once you have the raw photo, you have to put it on your dome. For most fulldome systems it’s pretty simple. Just display a sphere and set the photo as the texture on the sphere, and then move the viewer’s eye to the center of the sphere. Voila! You have a full 360° image on your dome.

If your fulldome system doesn’t allow you to draw spheres with textures, you may have to do that step with Blender or your favorite 3D animation software. Either way, it’s simple and easy. Did I mention that the app is free?

Its stitching is not always perfect, especially for close indoor shots. I’ve found that if you can hold the phone close to you and try to pivot the phone around a central point, you’ll get better results than if you hold the phone out at arm’s length. It’s also important to get every orange dot. If you miss a dot, you’ll be left with a back obelisk like gap in your photo.

An example: here’s my photo of Delicate Arch. I missed a spot, and didn’t discover my mistake until I got home. But a little playing with PhotoshopREG with a clone tool and I was able to make a workable photosphere. It would have been nicer to get the whole thing, of course.

It seems Google wants people to use the app to upload images to Google’s map and street view database. You can download these images from Google, but in my experience, the resolution is reduced and not good enough for fulldome use.

I only have experience with the Google app; there may be other 360° camera apps out there. This is a fast-changing field, with the advent of the VR headsets. I suspect it will only get easier to make these photospheres in the future, but it’s actually pretty easy now.

It’s easy enough to use that a teacher could give an assignment to their students to snap photospheres of the local community. A traveler could snap photospheres of their favorite vacation spot. The possibilities are endless. Oh, and did I mention that the app is free?

Based on a paper presented at the 2015 Great Lakes Planetarium Association Conference, October 14-17, Grand Rapids, Michigan.
bright: adjective  ɹɪt\ 1. producing a lot of light, having a strong color  
2. unusually intelligent, smart, able to learn quickly, “A ‘bright’ idea”

Here’s a brilliant idea - SciDome “IQ”: bright, high resolution, affordable fulldome projection systems designed and priced for educational planetariums

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*what’s your IQ?
Not all moving bodies in a planetarium show are astronomical in nature; some are just plain terrestrial. And just as there are thousands of planetariums around the world, there are probably thousands of such stories...

Those of us who work in planetariums are used to speaking in darkened theaters with live audiences and, for the most part, our visitors behave themselves and the presentation at hand runs without incident. Then there are those other times when something doesn’t quite go right on the audience’s part, but I think it has to be proven that the direct cause is that they’re affected by being in a strange and unusual environment (i.e. in the dark under a projected night sky while being in a dome).

During my decades under artificial heavens I have seen all manner of strange things; some the direct results of the audience’s more-or-less spontaneous creativity, while others were clearly premeditated.

I had started under the dome at the Strasenburgh Planetarium, which could be considered at the time (1972) the “flagship” of the Rochester Museum and Science Center. Sometimes schools would plan their visits so that classes visited both the museum and the planetarium, which were located right next door to one another.

This meant that for unloading of students they could either have the buses pull up alongside the museum in the public parking lot on the other side of that building, or in front of the planetarium in its own curved driveway. After visiting one or the other they could then walk the short distance across the small parking lot that separated the two buildings for their second visit.

Under the spreading chestnut tree

One thing that was noted in the beginning of the school year was that the students passing the front steps of the museum on their way over to the planetarium could pick up horse chestnuts from the ground under a tree that stood on one of the corners of the museum’s property that fronted East Avenue.

If you guessed that these chestnuts got tossed around in the dark of the planetarium during a school show you are either: 1) someone who has planetarium experience or 2) you are a pretty good guesser. Not only did other kids get hit by these flying nuts, but they sometimes also hit parts of the dome or special effects projectors behind the theater’s springline in the projection gallery cove space.

And this was not limited to Rochester or to chestnuts; I once experienced something similar with a group while at the Albert Einstein Planetarium at the Smithsonian’s National Air and Space Museum. During the talk I heard a large metallic “clack,” which, if you have been around planetarium domes long enough, you recognize immediately as something striking one of its perforated aluminum panels. Not hearing any more noise I continued with my talk.

After it was over a grade school-aged boy came up to the control console where I was standing and complained that he had been hit on the arm during the show by something. At first not connecting the two events of noise and his experience I asked him what it was and he held out his palm, which contained a steel ball bearing that was about three-quarters of an inch in diameter.

It was bad enough that it had hit someone—thankfully not in the face or head—but it certainly gave me pause to think if it had come down and struck one of the 32 star-projecting lenses on the Zeiss VIa planetarium projector in the center of the room, or had hit something in one of the two planet cages that separated the north and south starballs from the projector’s center section.

I still have that ball bearing today as it’s about the same size as the primordial body, the so-called “ylem,” that was the progenitor of the Big Bang that created the universe. And it is also about the same “ylem” size as the blue marbles that were made up to act as giveaways at premieres of the “Cosmos” IMAX film, that was sponsored by the National Air and Space Museum.

What goes up . . .

Some of the things that ended up with audiences inside of planetariums don't always respect the laws of gravity, which is more than fitting for a place associated with outer space. One day after a Strasenburgh weekend show the technician on duty called me into the theater between performances. All of the colored house lights and the white work lights located at the base of the dome were on, making the interior very bright.

(Continues on page 62)
smart:  adjective \smart\  1. adept at thinking, learning, or teaching, intelligent 2. guided or automated 3. appealing to good judgment, “A ‘smart’ choice”

The new “IQ” series SciDome projection systems deliver high-budget performance at an educator’s price. Available in 2400, 2560, and 4K resolution, SciDome IQ gives you ultra-high definition imagery and superior brightness. Why settle for more expensive displays that don’t offer the education features of SciDome?

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As I came through the control room door up the short flight of steps into the control console my eye was caught by a kid's helium balloon that was resting against the dome at the zenith. It had either gotten away by accident, or it was released on purpose; I certainly did not recall anyone holding onto a balloon as they came past me in the line of ticket holders on their way into the theater for that show.

The question was now how to get it down before the next audience came in. Strasenburgh’s dome was made by Astro-Tech and part of the installation was a curved ladder that ran up the back of the dome parallel to its curving surface. Wheels at the bottom and a pivot at the zenith allowed it to be rotated around the springline (the dome’s horizon) so that it could be moved where things needed to be taken care of behind the dome, such as the installation of sound system speakers, special effects projectors, even maintenance on the heating and cooling ventilation ducts.

Usually always comes down

The quick-thinking technician got a pin from somewhere and made his way up the dome ladder, climbing all the way up to the zenith. At that time there was a platform at the very top, which was used to hold some special effects projectors and theatrical spotlights that shown through the perforations in the dome’s aluminum sheets. From there he was able to stick the pin through one of the holes and pop the balloon, which fortunately did not fall down on top of the planetarium projector.

Believe it or not, but the exact same thing happened when I was at the National Air and Space Museum, though this time the technicians came up with another solution. One of them went out to the souvenir vendor’s trucks that lined Independence Avenue in front of the building and bought a helium balloon. Taking a piece of masking tape, they then attached a thumbtack on the top of the balloon so that its sharp point faced up. After adding a longer piece of string to the balloon’s original one, they let it rise up so that it came in contact with the tourist’s balloon that was up at the zenith. Pulling the string to bob our balloon up and down, the tack eventually pierced the other balloon, which fell to the floor. Makes you wonder how many times a year this happens in other planetariums around the world and how they solve the problem.

Except when it has wings

Not everything that is airborne, however, has to be a helium balloon. A Strasenburgh weekend technician once called me into the theater before the show ended as he wanted me to get the theater emptied out. A Strasenburgh weekend technician once called me into the theater before the show ended as he wanted me to get the theater emptied out

A Strasenburgh weekend technician once called me into the theater before the show ended as he wanted me to get the theater emptied out. This time it was a genuine surprise. Looking at the white surface of the planetarium’s starry night sky, or some dramatic scene, like a futuristic outpost on Mars or a dome full of spiral galaxies. Not everyone thought that they are able to take pictures of what they are seeing on the dome overhead, and you can’t really blame them in a way. It would make for a very nice picture to show someone else if you could capture a view of the planetarium’s starry night sky, or some dramatic scene, like a futuristic outpost on Mars or a dome full of spiral galaxies.

What they don’t think about in advance, of course, is that while it is normal to take a regular picture under low lighting conditions with a flash, in a planetarium show such a bright, though short-lived, light is normal to take a regular picture under low lighting conditions with a flash, in a planetarium show such a bright, though short-lived, light actually lights up the whole dome and—besides blinding everyone else in the audience in the process—the only thing they capture is the flash-lit white of the dome. Even the little flash bulbs on amateur cameras of the time were powerful enough to render the dome blank.

This was exactly what happened; one of the Girl Scouts had turned around, faced the control console and took a flash picture. Fortunately the technician caught it full in the face and was so surprised that both he and the stool fell right over backwards with him landing at my feet.

One of the problems in a planetarium show is that people think that they are able to take pictures of what they are seeing on the dome overhead, and you can’t really blame them in a way. It would make for a very nice picture to show someone else if you could capture a view of the planetarium’s starry night sky, or some dramatic scene, like a futuristic outpost on Mars or a dome full of spiral galaxies.

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You could say that that weekend technician went “bump in the night,” but from where I was standing in the control room doorway, it was more like a “crash” in the night.
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In the News from Around the Globe

Flandrau Planetarium

TUCSON, Arizona (Tucson News Now)—A generous gift to the University of Arizona means a new planetarium will soon fascinate families. Flandrau Science Center & Planetarium will renovate its planetarium, built in 1976, with new seats, a new seating layout, enhanced lighting, and a new acoustic wall treatment. The EOS Foundation, which is “committed to breaking the cycle of poverty by investing in children’s futures,” provided the funds needed for this update.

Two years ago, Flandrau installed a state-of-the-art fulldome digital projection system. The renovation will provide a better viewing experience of the shows for visitors. Shipherd Reed, the Marketing and Communications manager at Flandrau, writes, “The theater’s renovation will connect the next generation of Tucsonans to the science being done at the University of Arizona.”

Lenape Valley Planetarium

STANHOPE, New Jersey (New Jersey Herald)—The planetarium at Lenape Valley Regional High School was filled to capacity for three consecutive nights last week in what was a swan song for two Sussex County stars.

John Scala, the planetarium director and high school science teacher, announced his retirement earlier this year after 29 years at the helm of the school’s crown jewel. Following Scala’s announcement, the Lenape Valley Board of Education voted to move forward with plans to repurpose the planetarium for lab space.

Radford University Planetarium

RADFORD, Virginia (WDBJ7)—Radford University is showing off its new planetarium.

The globe-shaped room is a staple in the new Center for the Sciences building. It has 55 seats and all digital projection and surround sound systems.

The university dedicated the planetarium with help from Michelle Larson, the president and CEO of Chicago’s Adler Planetarium, and Shane Larson, a research associate professor of physics at Northwestern University.

“This is just a continuing part of Radford University’s educational mission. This is what we do, we teach people. We teach our students, we teach the general public, we teach anybody that’s here,” said Rhett Herman, a Radford University Physics professor.

A joint “storm heaven” in Berlin

Der Tagesspiegel, Berlin—Soon they will jointly storm heaven: The Zeiss Planetarium in Prenzlauer Berg, the Archenhold Observatory Treptow and the Wilhelm-Foerster Observatory on islanders in Schöneberg.

Three traditional institutions that have dedicated themselves to astronomy, but so far circled on separate tracks. They should go together on space patrol from 1 July. The Senate decided, after years of discussion, to establish a foundation under public law.

Berlin would thus become the “location number 1 for the popular science astronomy” in Europe, said Education Senator Sandra Scheeres.

The Zeiss Planetarium, opened in 1987 as one of the last major projects of the GDR, renovated two years ago and brought to the latest technical standard. It should—after the re-opening this summer—be Europe’s largest “science theater.”

SciDome in New Mexico, Georgia

CHADDS FORD, Pennsylvania—Spitz Incorporated has announced that the New Mexico Museum of Space History in Alamogordo has ordered the SciDome 4K Laser fulldome planetarium system, replacing the legacy projectors in the Museum’s Tombaugh Space Theater.

“Spitz is thrilled that the New Mexico Museum of Space History chose the SciDome 4K Laser system for their theater,” said Jon Shaw, President and CEO of Spitz. “Their educational mission and requirement of a high performing projection system will be well served with this selection. Audiences will love the experience, and we’re glad to continue our long partnership with the Museum.”

The company also announced that the Dekalb School System in Atlanta, Georgia, has ordered the same model for the Fernbank Science Center. The 70-foot-diameter Jim Cherry Planetarium is the largest planetarium owned and operated by a public school system.

Digistar5 selected in Wisconsin

In September, the Daniel M. Soref National Geographic Dome Theater & Planetarium (Dome Theater) at the Milwaukee Public Museum (MPM) will replace their giant screen 15/70 film system with a new 8K Digistar 5 immersive digital cinema/digital planetarium system from Evans & Sutherland.

The upgrades are part of the $1.6 million dollar revitalization gifted to MPM by the Daniel M. Soref Charitable Trust. The Trust also funded the development and creation of the original Daniel M. Soref Planetarium in 2006 and its 3D update in 2013.

The Milwaukee Public Museum is a natural and human history museum located in downtown Milwaukee, Wisconsin. The museum was chartered in 1882 and opened to the public in 1884. MPM has three floors of exhibits that encompass life-size dioramas, walk-through villages, world cultures, dinosaurs, a rain forest and a live butterfly garden, as well as the Daniel M. Soref National Geographic Dome Theater and Planetarium. The museum houses more than 4 million objects and hosts nearly half a million visitors each year. The MPM is operated by Milwaukee Public Museum, Inc., a private, non-profit company, and its facilities and collections are held in trust and supported by Milwaukee County for the benefit of the public.

Shrikrishna Planetarium digital

Patna (The Times of India)—The first digital planetarium of Bihar will come up on the premises of Shrikrishna Science Centre near Gandhi Maidan here. Official sources said the planetarium will also have a display gallery with information about our planets, constellations, Chandrayan (India’s Moon mission), Mars missions, payloads, topics of astronomical significance, and curiosity. “We will also have statues of Aryabhata, Vikram Sarabhai, and Kalpana Chawla at the centre to inspire the young minds,” said a source associated with the project.

Curator of the centre, Swaroop Mandal, said the place has been attracting a large number of visitors, particularly school students from all over the state, since its inception in 1978.

The centre has been playing a key role in realizing the national goal of inclusive “science education for all” through non-formal mode.

Apart from its permanent galleries with a number of participatory exhibits on science, the centre will also organize regular educational programmes and activities, especially for the students, to inculcate scientific temper in them by imparting science education in a non-formal way.
With the GeoDome™ Evolver, today’s planetariums can support their proven, effective approaches to science education with the versatility and precision of premier digital display systems. The Evolver is easy to incorporate and enables you to either complement or replace your existing starball machine.

The Evolver is the simplest and most cost-effective way to bring digital projection capability into your planetarium. Benefits of the OmniFocus™ digital projection system include:

- Resolution up to 2560x1600
- Optimized pixel placement in your audience’s line of sight
- Easy setup, operation and content creation
- Low maintenance costs

Packages including installation, training, & support start at $35,000

**EVOLVER COMPONENTS**

- OmniFocus Projector & Cabling
- Image Generating PC
- Wired and Wireless Interfaces
- Permanent or Portable Mounting
- Installation & Training
- Optional 5.1 Audio System

**SOFTWARE OPTIONS**

- Expand your programming with content from traditional night sky observation to the furthest reaches of the Universe and orbital views of Earth’s natural systems in action.
- Uniview
- Eyes on the Solar System
- WorldViewer
- DomeView Pro

**GEODOME NETWORK**

- Collaborate with leading educators
- Download exclusive content
- Join domecasts for professional development and public events
- The Elumenati provides direct hardware and content support

“The Elumenati Evolver has redefined astronomy education for us. Teaching concepts that were once out of reach are now an everyday lesson plan. Teachers and the general public marvel at what we can show and teach them, and we are constantly discovering more that we can do.”

— Matt Linke, University of Michigan Museum of Natural History Planetarium

“The GeoDome Evolver system from Elumenati is the ultimate system for the 21st century planetarium. The combination of top of the line projection and software gives the planetarian a plethora of resources to customize and immerse their audience into a truly out-of-this-world experience. You will not be displeased!”

— Derek Demeter, Director, Seminole State College Planetarium, Sanford, FL
Dear fellow planeterians:

When I edit this section, it always strikes me how many different and diverse shows, events and activities there are taken place in our large family of planetariums. It is also very reassuring to see how recurring events like Printemps des Planétariums, Yuri’s Night, and others can attract a growing number of visitors and become well known and loved celebrations by the audience.

For this section I’m indebted to contributions from Ignacio C. Pinal, Rachel Thompson, John Hare, Bart Benjamin, Milene Wendling, Björn Voss, Aase R. Jacobsen, Loris Ramponi, Alex Delivorias, and Vadim Belov.

We will begin this tour around the globe in the lovely Caribbean summer.

Association of Mexican Planetariums

A new planetarium is being built in the northwestern state of Nayarit. It has an 8-meter dome being equipped with an Evans & Sutherland Digistar 5 SP Projector and seating for 38. The tentative inauguration is around mid-2016. The planetarium is part of the Interactive Science and Innovation Museum in Tepic, capital of Nayarit, a place dedicated to inspire and teach present and future generations about human development and the impact science, technology, art, and innovation have in our lives. It has five interactive exhibit halls to discover, learn, reflect, transform, and explore and top-of-the-line exhibits, facilitating an interactive, free and hands-on learning experience to the visitor.

Southeastern Planetarium Association

For those of you who are looking for a great location for observing the total solar eclipse on 21 August 2017, the Southeastern Planetarium Association (SEPA) is offering a fantastic opportunity! The eclipse centerline runs through Land Between the Lakes National Monument, in western Kentucky, USA. Lake Barkley State Resort Park is located within Land Between the Lakes and SEPA has reserved the entire lodge for the eclipse.

Accommodations at the lodge are being made available to SEPA members on a priority basis. On an as-yet to be specified date, remaining rooms will be opened to the general public. Cabins and cottages are already sold out, and all other rooms (accommodate up to four persons) are expected to be booked prior to the eclipse. The resort reservation’s desk maintains a list of current membership so identify yourself as a SEPA member to qualify for the booking. You can find detailed information about the facility at www.parks.ky.gov/parks/resortparks/lake-barkley.

For membership applications, activities, and other events visit SEPA’s website at www.sepadomes.org.

Great Lakes Planetarium Association

Illinois. The Cernan Earth and Space Center at Triton College in River Grove signed its final license agreement for fulldome content in February, allowing the Cernan Center to make a clean break to all fulldome programming.

In 2015, Chicago’s Adler Planetarium welcomed over 550,000 guests through their doors, more than any other year in the last twenty. Adler is collaborating with Mike Brown and his research team on a new program about the possible new planet in the solar system. In mid-January, Adler hosted the global launch event for the Air Jordan XXX basketball shoe.

The William M. Staerkel Planetarium at Parkland College in Champaign once again hosted Girl Scout sky badge workshops in April and Boy Scout astronomy badge workshops in May. Also in May, the planetarium hosted its Head Start Science Night and observing events at the Middle Fork Forest Preserve and the Camp Kiwanis Girl Scout camp.

The Elgin School District’s U-46 Planetarium is on track to see about 16,000 school groups this year and another 1,000 scouts and public visitors. Tweaks and adjustments to the school presentations to better align with the Next Generation Science Standards have been a focus this year. The planetarium will co-host an event with the Gail Borden Library in Elgin.

In Peoria, Renae Kerrigan from the Dome Planetarium at the Peoria Riverfront Museum spoke about real space places that mimic the Star Wars universe before the premiere of the new Star Wars movie in their giant screen theater. In February, they hosted two Romance Under the Stars events and held a Yuri’s Night celebration in the spring.

Indiana. At the Koch Immersive Theater in Evansville, Mitch Luman and his staff have created a live Native American show. His team has also been experimenting with the creation of open captions for their fulldome shows. During a week in March, GLPA’s incoming President Dayle Brown from South Bend gave presentations to school children in her Starlab within the Art Center.

(Continues on page 68)
Planetariums for Nature
join the movement

The LIFE of TREES
the environmental fulldome program

www.lifeoftrees.com
The Schouweiler Planetarium at the University of Saint Francis in Fort Wayne had another very successful WinterFest in February that consisted of eleven music laser light shows from AVI, three evening programs, two family matinees, and two Valentine Evenings.

(Editor's note: The University of Saint Francis announced at the end of April that it planned to close the planetarium and renovate the area as a study and socializing area. At deadline, initial discussion was taking place about moving the planetarium to an off-campus site.)

Michigan. In Bay City, the Delta College Planetarium has organized a number of new special events. A new in-house live narrated production called Dateline Mars ran in April and May to take advantage of the opposition of Mars. The planetarium participated in the Statewide Astronomy Night on 15 April. A new monthly series called Sky Treasures is a joint project between the planetarium and the local PBS affiliate.

The Kalamazoo Valley Museum is pleased to announce that Mark Reed (formerly of the Hurst Planetarium in Jackson, Michigan) has been hired as its planetarium manager. Programming for spring 2016 includes Invaders of Mars as their feature show about the Red Planet. The Artist’s Sky discusses how the grandeur of the night sky has influenced works of art, music, and literature.

The Longway Planetarium is beginning production of its first full production with their new Digistar 5 system. The show discusses forces and is aimed at a 3rd-5th grade level. The Flint Cultural Center, which includes the planetarium, offered a free day for Earth Day on 23 April.

In Ann Arbor, twin 10-story cranes have begun their work on the new biology building site, the new home of the University of Michigan Museum of Natural History and its planetarium.

The Abrams Planetarium at Michigan State University will be adding a new display of meteorites from China to celebrate MSU’s theme year on China. They received a grant from the Dart Foundation to install and build content for three interactive kiosks. On 15 April they hosted the first annual Statewide Astronomy Night.

Last fall, the Eastern Michigan University Planetarium piloted a new program called “Date Night.” They now use a live polling system whereby the audience chooses the show.

In Detroit, the Michigan Science Center underwent a reorganization at the beginning of the year. Education and theaters are now combined into one department.

Ohio. The Ward Beecher Planetarium at Youngstown State University has hired a new planetarium lecturer, Tiffany Wolbrecht, and announced that they have begun a search for a digital content designer as part of a NASA grant awarded to CosmoQuest. Ward Beecher is the planetarium part of the CosmoQuest project.

Laura Megeath reports that her Appold Planetarium at Lourdes University and the Toledo Symphony Orchestra will begin a new collaboration. Prior to each planetarium show, visitors can now enjoy the sounds of the Toledo Symphony!

The Vandalia Planetarium at Smith School near Dayton began its season with a special on Pluto, followed by one dedicated to constellations.

At the Westlake Planetarium, Jeanne Bishop has been working on making a video that documents how best to teach seasons and other astronomy concepts. The video is for the International Planetarium Society’s Education Video project, similar to GLPA’s own Live from the Planetarium project.

Wisconsin/Minnesota. Plans are moving forward for the opening of the new Bell Museum and Planetarium on the University of Minnesota’s St. Paul campus in 2018. Architectural designs are complete, and groundbreaking was planned for Earth Day 2016.

The Gary E. Sampson Planetarium is pleased to report that it will be getting new seating during the summer. The Buckstaff Planetarium at the University of Wisconsin-Oshkosh will be undergoing renovations and is scheduled to reopen in September 2016.

The Manfred Olson Planetarium at University of Wisconsin-Milwaukee is celebrating its 50th anniversary this year! To mark the event, it hosted a Celestial Celebration on 23 April in the new Kenwood Interdisciplinary Research Complex.

Paul Larson is the new planetarium director at the Mayo High School Planetarium in Rochester, Minnesota.

The Minnesota State University Moorhead Planetarium in January hosted “Stars of PBS,” an event in cooperation with PBS and Prairie Public Television, that attracted more than 500 people. The MSUM Planetarium recently was awarded $58,000 for hardware upgrades.

The Soref Planetarium in Milwaukee is running its original production Did an Asteroid Really Kill the Dinosaurs?, which features footage from Gubbio, Italy, where the iridium layer was first discovered in 1977.

Southwestern Association of Planetariums

This spring, two weeks of spring break brought vacationers and campers to the Perot Museum of Nature and Science, Dallas, Texas. Dozens of campers attending Friday astronomy-themed days visited the Portable Universe planetarium. Campers attended programs highlighting planets and stars in the evening sky. Each learned how to find and identify Jupiter. From there, they looked for Leo by finding the curve of the asterism, the Sickle, and traveling north from there, looked for Ursa Major. Texas is notorious for intensely varied, spring-time weather. However, clear nights in early March offered observing opportunities for Jupiter’s opposition.

Society of the German Speaking Planetariums

ESO’s Supernova Planetarium building progresses. On 12 April the impressive starry roof for the planetarium and visitor centre building was installed. The roof, which weighs almost 30 tonnes, consists of glass panels set into a metal framework made of triangular sections—262 of them in total—arranged to artistically represent some of the constellations of the southern sky. It was constructed by the South Tyrolean

Tiffany Wolbrecht

SWAP: The “Local Group” at the Planetarium at University of Texas at Arlington for friendship, food, and planetarium-ing. Left to Right: Levent Gurdemir, Scott Sumner, Kyle Doane, Amy Barraclough, Chris Miller (top), Linda Eaton (bottom), John Pogue, Rachel Thompson, Donna Pierce. Courtesy of Nathan Eaton.
family company Frener-Reifer after an idea from Bernhardt + Partner architects working together with ESO’s astronomers. The whole roof was installed in one single lift using a special 500-tonne crane.

Housing a state-of-the-art digital fulldome planetarium and more than 2200 square metres of exhibition space, including digital interactive stations developed by the Heidelberg Institute for Theoretical Studies, the centre will lead visitors on an exciting journey through the living universe. Conference facilities will host a variety of lectures, workshops, and meetings. Entry to the ESO Supernova will be free of charge and all content will be delivered in both English and German. The facility will be finished in early 2017 and is scheduled to open to the public in late 2017.

A show produced in 2012 by the planetariums in Münster, Bochum, Kiel, Mannheim, Osnabrück, and Wolfsburg titled Distant Planets–Alien Life will now be released for free. The show features then-current projects like the Kepler telescope, and shows some of the best known exoplanets at that time that might harbor life. It also contains some fictional elements, including what alien life might look like. For any questions concerning this release, please contact: bjoern.voss@lwl.org. The show will be made available through ESO’s website, with kind support of the “ESO Supernova” team.

**European/Mediterranean Planetarium Association**

_Croatia._ April was a busy month for the Rijeka Astronomical Centre (RAC). On 2 April, it celebrated its 7th anniversary, while on 4-9 April, it organized the Dark Sky Week, an event highlighting the detrimental effects of light pollution to the observation of the night sky. The event included lectures by representatives of the Cezar Association for the Promotion of Energy Efficiency and presentations of the steps taken by the City of Rijeka to reduce the negative effects of light pollution.

Also in April, RAC organized a science festival under the main theme of “Science and Art.” The event included films and interactive shows at the planetarium, public lectures by members of the Academic Astro Studies, the centre will lead visitors on an exciting journey through the living universe. Conference facilities will host a variety of lectures, workshops, and meetings. Entry to the ESO Supernova will be free of charge and all content will be delivered in both English and German. The facility will be finished in early 2017 and is scheduled to open to the public in late 2017.

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nautical Society Rijeka, and night sky observations through RAC’s telescope.

Last—but not least—visitors could also enjoy the exhibit Universe that was created by children’s hands and imagination. On 12 April, during the Yuri’s Night event, commemorating Gagarin’s legendary journey onboard the Vostok 1 spacecraft, visitors to the Centre had the opportunity to watch two planetarium shows, namely Race to Earth for the younger audience and Back to the Moon For Good for adults.

Greece. The Eugenides Planetarium in Athens premiered its latest digital planetarium show Life in the Universe on 8 February. The show, focusing on the fascinating possibility of life beyond Earth and the search for exoplanets, was introduced to the public by Xenophon Moussas, an astronomer at the University of Athens, and included three free-of-charge screenings.

On Tuesday 23 February, in collaboration with the Association of Greek Physicists, it organized a public lecture by Theocharis Apostolatos, Section of Astronomy, Astrophysics, and Mechanics, Department of Physics, University of Athens, on the detection of gravitational waves. The Great Auditorium of the Eugenides Foundation was filled to capacity by more than 400 people who enjoyed enormously the lively and stimulating lecture by Apostolatos, who obtained his PhD in 1994, under the supervision of the great American theoretical physicist Kip Thorne.

On Tuesday 8 March, the Eugenides Planetarium premiered the digital planetarium show Fly me to the Moon. Finally, on 21 March, the National Observatory of Athens (NOA) celebrated, under the dome of the Eugenides Digital Planetarium, 170 years of scientific research with the publication of a book on the history of NOA, presented to the invited guests by Canaris Tsinganos, director of NOA, and by his European colleagues Bodo Zeigler, director of Vienna Observatory, and Claude Catala, director of the Paris Observatory.

Society of French Speaking Planetaria

The Printemps des Planétariums was held on 19-27 March. Fifteen planetariums were involved in this 9th edition. Planetarium shows, visits of expositions, and animations on the seasons and spring equinox gave rhythm to these days to celebrate the new season and the return of warm weather. Visitors during this spring time event are more numerous each year and all the participating planetariums hope 2017 will be exceptional for the 10-year edition.

A large number of planetariums prepared for the event of the transit of Mercury on 9 May. They organized the observations for the public, since the phenomenon was perfectly timed to be visible during the afternoon.

Cité de l’espace in Toulouse is preparing IPS 2018 Conference with a first major step: the complete refurbishment of its 20-m dome planetarium. The renovation will include the projection, simulation, and sound systems, plus interactive pads for each of the 280 renewed seats. In addition there are newproduction tools and a render farm as well as recarpeting and dome painting.

The call for bids was launched last March by the City of Toulouse. The selection of the group of companies will be made through a competitive dialogue. The final selection is planned for December 2016 and the reopening for June 2017, just one year before your visit for IPS 2018. A bientôt!

After the southwest of France (Toulouse), new installations move...
into the northeast. Indeed, the University of Strasbourg launched its tender last March to equip its new 15-meter planetarium in 2019.

**Nordic Planetarium Association**

The year 2015 was a good one for Denmark’s astronomical heritage centres. Rising visitor numbers, sold out events, and great interest in social media are reported by Denmark’s four astronomical attractions. There are unanimous reports on an increased interest in stars, space, and science from children and adults alike.

At the country’s largest astronomical attraction, the Tycho Brahe Planetarium in Copenhagen, there has been an increase from 106,000 to 141,600 visitors the last two years. They have seen a growing interest in astronomy and space events. A new feature on the first Saturday of each month is the live show So Far Away in the large space theatre specifically designed for families.

That interest in space and astronomy is growing can partly be attributed to the great attention devoted to Denmark’s first astronaut, Andreas Mogensen. Likewise, an astronomical phenomenon like the March 2015 solar eclipse hits wide and creates the basis for an increased interest in astronomy, and the country’s astronomical communication centres jointly have used as a springboard for new initiatives.

The Brorfelde Observatory has been overwhelmed and delighted with the great interest for this new astronomical activity centre, which is not even officially open yet. The visitors are very concerned about what the universe contains and become curious to learn more about space, stars, and science.

The Brorfelde Observatory is located just outside of Tølløse, Zealand and is opening its doors officially in June. In the framework of the University of Copenhagen’s old observatory, there is an exciting adventure under development in the historically-protected buildings.

At the Orion Planetarium in Jutland, the number of visitors increased from approximately 7,700 in 2014 to about 8,800 in 2015, a healthy increase of more than 1000 people. Much of the increase is due to school visits, which have taken advantage of the various offers in nationwide project Space Odyssey 2015. Many children and adults followed the launch of Mogensen on 2 September 2015 from the planetarium, and throughout the year many students from schools across the region participated in competitions, heard lectures, and travelled through solar system under the planetarium dome. Especially popular were the activities where students could train to become astronauts.

Also, the Steno Museum in Aarhus credits Mogensen for the increased interest in space and astronomy. They made events both for schools and for the general public throughout 2015 and experienced a great interest and participation. For example, in collaboration with the Stellar Astrophysics Centre at the University of Aarhus, they succeeded in getting more than 400 children and adults to gather at 5.30 a.m. on 2 September and follow the exciting launch of Andreas Mogensen by live stream from Baikonur in the Lakeside Lecture Hall.

**Italian Association of Planetaria**

Space art is an interesting subject for planetariums. Some images created by space artists are very spectacular under the dome. “Space art” (also “astronomical art”) is the term for a modern artistic expression that strives to show the wonders of the universe. Space artists use more than illustration and painting to communicate scientific discoveries; some also have had the opportunity to work directly with space flight technology and scientists in attempts to expand the arts, humanities, and cultural expression in relation to space exploration.

Among space artists there is the Italian Deneb Arici who collaborates with the Planetarium and Observatory Serafino Zani. Deneb is attracted by the innate appeal of boundaryless outer space. As a painter and an amateur astronomer he combines visual and perceptive study with the scientific one, thus giving light to the project Stargazing Mixed with Art and is recognized as one of the artists of the prestigious IAAA, International Association of Astronomical Artists.

IAAA is the premier organization and only guild in the world dedicated to the creation of space art. Composed of over 120 members, artists of the IAAA depict the wonders of the universe in ways to inspire the greater human population and raise awareness of space. Deneb is one of two Italian members of the organization.

(Continues on next page)
Stephen Case, director of Strickler Planetarium, Illinois, USA was in April involved in Perugia, Assisi, Brescia, and Gorizia for the yearly tour of astronomical lessons organized by the winner of the initiative Two Weeks in Italy. (See his report starting on page 78.)

At the end of April, the Planetarium of Bari hosted the yearly Italian Association of Planetaria national meeting.

During the transit of Mercury in May the institutions involved in the “Planitalia” project presented together their programs with public observations of the event.

The next National Day against Light Pollution will be held on 29 October. Planetariums are involved in this through special events, public projections, and astronomical evenings.

The Starflight-A Handy Planetarium Association's workshops for schools have been very successful, especially their Handy Planetarium. The workshop helps students to understand by themselves the structure of the celestial sphere and its movements.

In February the association worked with middle school students at the Bonfigli School in San Mariano near Perugia. First of all, the students used different ways to find various constellations on mute sky maps. The second step consisted of identifying the same constellations on the Handy Planetarium.

At the end, by rotating the paper-model, they observed how constellations move in the sky during the night. The students also tested the movement of stars at different latitude. They were very proud to have discovered all the information by themselves and applauded enthusiastically at the end of the workshop.

Giovanni Murelli, who drew up the Handy Planetarium, has produced other interesting astronomical drawings to build new kinds of educational paper-models that will be used to organize new workshops.

Russian Planetarium Association

Kirov. The planetarium marked the International Day of Planetariums on 20 March. The International Day of Happiness and the day of the vernal equinox also fell on the same date. The program, which included six sessions, was offered to the adult and young visitors, accompanied by games, quizzes, and a blitz-tournament with questions about the Earth and space.

Nizhny Novgorod. All halls in the planetarium were in use on 13 March and an original program was awaiting visitors in each of them. Creative workshops in a lobby were running for kids, where they got a chance to do an asterism with their own hands as a keep-sake, to execute interesting tasks, and to solve crosswords. Members from the astrocosmic group conducted master-classes. They answered questions about the sun and moon, Mars and Saturn, and Earth. Despite the changing and cloudy weather, some visitors were lucky to observe with a telescope and to admire the sun.

Perm. The new-year performances of the optical theatre “Let’s, let’s meet New Year” opened the year 2016 at Perm Planetarium. A mischievous monkey, Anfiska, having never seen snow nor constellations of the northern hemisphere, made a commotion. She even managed to climb high to the moon and to swing on it, like on a swing.

On 13 March the premiers of the year were presented in the full-dome programs Riddles of the Sun, Space address of the Earth, In the depth of the Universe and the performance of the optical theatre “Wonderful fairy-tale of Starry house.” A creative workshop called Star Showers was run in a lobby, as were traditional games and competitions on making paper airplanes and picture drawing and “Lessons for the clever and the sharp” were conducted there. Not only children but also adults actively participated in the quiz “Miniature of sky is a Planetarium!” The public of Perm observed the rendezvous of the moon and the orange giant Aldebaran with a telescope and binoculars.

Samara. On 13 March, the planetarium of the Center of out-of-school education organized Readings of Cosmonauts, devoted to K. Tsiolkovsky, in the Samara Museum. The 20 participants included members of children’s age groups up to 14 years old of this and nearby centers.

Sankt Petersburg. A colorful playbill invited children to make a pocket planetarium and a star trap on 13 March. With great fascination children cut out the starry sky from cardboard and drew favorite constellations on it. They searched constellation of the March sky by means of the “trap” made with their own hands.

Clips about the Saint Petersburg Planetarium and planetariums around the world were shown in the dome and on monitors in a lobby before every program. The audience participated in quizzes, too. A special program, The First Russian planetarium, was devoted to models of the starry sky from the most ancient times to our days and to the famous Gottorp-planetarium (medieval Germany, 1651-1664) kept in the museum, named after M. Lomonossov (Kunstkamera).

Vladimir. The planetarium welcomed the cosmonaut A. Skvortzov on 15 December 2015. Veterans of the space center Baikonur became the honoured guests. The planetarium prepared to celebrate the Day of Russian Science with a new cognitive-educational program for the 6 grade students called School of Entertaining Sciences. The program consists of three parts: scientific workshop (demonstration of safe experiments on physics and chemistry), a quiz on astronomy and cosmonautics, and a lecture-session, “Initial Information about the Universe.”

Kaliningrad. The “space navy” of the Academy of Sciences of the USSR was created by the initiative of S. Korolev in 1959. This was connected with preparation of launches of the first automatic space stations, and also the pilot-controlled spaceship Vostok. The fleet consisted of 17 research ships. Now only one remains, Cosmonaut Viktor Patzaev, situated at the moorage of the Museum of World Ocean in Kaliningrad since 2001.

A “submarine” planetarium (Continues on page 80)
SOLAR SUPERSTORMS
Narrate by Benedict Cumberbatch
Back to Basics IV—Discipline

The following list covers a few points that have aided me in my work in the dome with the public as well as with school children. Of course, all my lessons are interactive with strategic use of storytelling, kinesthetic movements, music, singing or sometimes worksheets to record observations/predictions and conclusions. These activities tend to keep students busy enough that there is little need for direct discipline strategies.

Tip: Introduction

Introduce yourself, the planetarium, and the main points of the program to be covered; tell them what to expect, look or listen for.

Walk very young children all the way around the dome. Touch the dome gently. Talk about what it looks like and feels like. Do not tell children that there is nothing to be afraid of in the planetarium. All they will hear is the word “afraid.”

Show them the “door,” open/close, dome deflates/inflates; explain portable planetarium’s fan inflation and support.

I suggest you enter the dome first to control the equipment and the seating. Train the teacher as the “door person” allowing 10-15 students to enter at a time, maintain order, watch for tripping on entering the door, and close the door to re-inflate when needed. Mention they are responsible for the exit procedure too.

When inside, take charge of the planetarium classroom immediately. For young children you can try saying, “Hands on your heads, hands on your shoulders, hands on your hips, hands on your lips. Now look all around and notice everything.” Or sing a song!

For older students one way to do this is to move students into different seating places for no particular reason! (i.e. “Would you sit here and you there. That looks good, now we can begin”). Or recite a poem! Have them tell you what they notice about the inside of the dome. Explain the model (You are on Earth looking at the sky—a smaller version of the night sky etc.)

Explain what will happen next and then distribute any materials if needed (i.e. papers and pencils).

Anticipate Trouble

Tell students what to expect and what you expect of them. Keep it simple! Give the “active” students a “job” that helps you, like “Keeper of the Light,” a student who turns on and off the entrance/exit light.

With very young children, dim the lights slowly and never turn all the lights out without their permission.

If someone says they are afraid you can explain that it is ok to be afraid! Sometimes simple acknowledgement of what they are feeling works. Give students a job to do and/or you can ask them to sit by you or their teacher, or for very young children they can hold a doll or stuffed animal (later you can point to a constellation in the sky that is the character of the doll or animal). Or the teacher can have a low level red light to hold for the child sitting by him/her.

Give Gentle Reminders

“I know that you are excited and we will have times for you to talk. Right now you need to remember if one person is called on to speak, we all must listen.”

With your younger audience use something like something I mentioned before - a “Simon Says” game (“Hands on your heads, hands on your shoulders, hands on your hips, hands on your lips. Now look all around and see if you can find the...and point to it.”). Many teachers have little rhymes to control behavior for instance, “Remember you are sitting on your sitters” and “crisscross applesauce” (children know to sit with crossed legs). Use the brief pregnant moment that follows to give the next direction. (“Look over here...” or “Did you notice...”)

Distract to a Positive Model

“I really like the way that you are all showing me you are ready to listen and learn.” “I like the way you are raising your hands and waiting to be called on.”

“Great! What is your name? Good job (child’s name), I like the way you thought that through. For younger children keep it short, “Wow, you look ready to look, listen and learn!” Refrain from using excessive praise and repetitive strategies; they will know it is phony.

To help kept one person from answering all the questions or everyone shouting out, you can ask them to discuss what they notice with their “elbow partners” (the people right next to them) and then ask for volunteers to share their thoughts or point to what they noticed.

Inject Humor

Keep the humor age-appropriate and positive. Sarcasm is never appropriate.

Offer Choices

Build in times when students can direct the course of the lesson. (ex. “Would you like to hear a story about a bear or would you like to hear a story about a dog?”)

Expect students to want to share what they know or are interested in. To keep the presentation moving, direct what they tell you to the next part of the lesson...be creative. (If someone says, “I like the moon.” You could reply, “Wonderful, let’s look at the moon right now!”Etc.)

The ultimate attention device is to turn off the stars and turn up the house lights and then restate behavior expectations and some choices...the last resort choice is to end the lesson or to go on.

You can find other Back to Basics topics that have been covered in this column in Planetarian archives on the IPS website at www.ips-planetarium.org/?page=plntarchive

Part I—Presentation and Evaluation: Here you will find some strategies for presenting effective live interactive lessons. 2011 December, Vol. 40, No. 4, 56 and 58

Part II—Developmental Characteristics: This one describes developmental characteristics of the various age groups that will enhance your
New Planetarium in Mexico

I received a wonderful email, in March, about a new portable planetarium in business. My contact in Argentina, Oded Kindermann, wrote, “I am happy to send this email with some great news from Mexico. I met Rene Gonzalez by accident in the Nightshade forum while I was asking for some troubleshooting. Rene was kind enough to help me and we discovered that we share the same passion for astronomy and mobile domes. After sending some emails to each other about our work, I invited him to write a note to the IPS Mobile Committee so that the world can also know about the wonderful work he is doing in Mexico.”

He continued, “It’s very interesting and surprising to meet new colleagues that have gone through similar experiences we did in the past, trying to define our lives and economical future for us and family by choosing astronomy and mobile domes as a way of living. I welcome Rene and his wife Angelica to the IPS Mobile Committee and I hope this note will also help them to achieve new goals in their local community.”

Thank you Oded, I am so pleased to hear about this new planetarium and the tale of its beginning. So here is Rene and Angelica’s story; Rene answered questions for me from a questionnaire I designed and he revealed a remarkable story.

How and why did you get started in the business?

It started, I guess, as with most of the people who are amazed by astronomy and science. I got into astronomy one step at a time, starting by reading articles and books, going out and trying to recognize constellations, getting a pair of binoculars, getting a telescope, and so on. At one point I wanted to share how passionate science could be and as Carl Sagan said, “After all, when you’re in love, you want to tell everybody.”

Angelica, my wife, and I wanted to start a small business and we were looking for a good idea for the business. The very beginning of the idea for starting a mobile planetarium was on a night when I was listening to a podcast of Mexican astronomers called “Obsesión por el Cielo,” they were talking about the most important planetariums in Mexico. At the end of the podcast they made a small mention of mobile planetariums, and then “Eureka,” I remember that I turned my head to Angelica and I said, “a mobile planetarium!” The idea came true in the next 4 years.

How did they fund the business?

Well, we went to Canada seeking a better life. We started to work, as most of the immigrants do, in factories, landscape, janitorial services, construction, etc. We spent seven years there and at a point we did not find a way to stay legally in Canada, so we decided to make some savings and then come back to Mexico and open a small business.

What equipment are they using?

We are using the system created by Paul Bourke, which is the spherical mirror system. We project the presentations through a VLC warper. The dome manufacturer is a guy who is in the business of inflatable structures, like castles, pools, etc. He also makes domes at a very reasonable price; there are some other manufacturers that sell the same structures at almost double or triple the cost.

That second door that you see is an emergency exit; he also makes the entrance funnel but he sells it separately. The only inconvenience, as I told Oded, is the weight of the dome; mine is about 90 kilos (about 198 lbs), which sometimes make it difficult to handle. On the other hand it is perfect for exteriors; outside could be sunshine in the afternoon and 25 degrees (C) and inside is totally fresh; it can resist mild windy weather very well.

Who do they serve (what age groups and venues)?

We have presentations that are suitable from kindergarten and elementary school to high school, college, university, and general public. Although most of our presentations are in schools, last year on November 15 we were part of the national “Night of the Stars.” The topic was the International Year of Light. We presented 6 shows during the event; it was free and open to everybody.

The event includes everything about astronomy, many, many telescopes, conferences, games, day time and night time observation, experiments, and of course mobile planetariums. There were 3 mobile planetariums at the event (we were one of them), and the response of the public was amazing.

An hour before the show started we had people wanting to go inside the planetarium though there were no more tickets; we gave away 45 tickets and we had at least 100 people waiting for a ticket. The event takes place all around Mexico and this one, at the National Autonomous University of Mexico, is the biggest venue. This is (Continues on next page)

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1Nightshade is a simulation and visualization software for teaching and exploring astronomy. http://www.nightshadesoftware.org
the website of the event: www.nochedelasestrellas.org.mx.

How many days do they work and what topics do they cover in presentations?

It depends definitely on the number of students of the school that we are visiting. On average elementary schools in Mexico are around 400 students so we expend 3 days in the school making 4 presentations a day. We try to not overfill the planetarium in order to maintain safe and comfortable environment for the public. The topics that we cover are mostly astronomical topics, from basic astronomy to cosmology.

We don’t have a budget yet to get fulldome movies so we improvise live presentations with Stellarium or Nightshade. We also project clips that we had gotten from the British Fulldome Foundation. Also we offer to the schools that if they are interested in a topic that is not astronomical we might develop it, like legends that people told in ancient times in Mexico and around the world.

Rene explained that when they went to present the project at a preschool, called Ignacio Lopez Rayon, they suggested that the teachers could dedicate the entire week to topics related to astronomy and the solar system. And on the final day of the week dedicated to astronomical topics, they were at the school with the planetarium and the school had asked the parents to make the experience more realistic by sending the kids to school with an astronaut costume.

Rene exclaimed “Imagine the experience for the kids who were, for the whole week, learning about astronomy and then coming into the planetarium with their helmets on; the costumes making them really imagine that they were travelling to space and were real astronauts!”

He mentioned that this was not an idea they came up with. They learned it from another school that they had attended before; that school came up with this idea for the kids.

He says, “So we were surprised when we saw the kids dressing as astronauts! There are no pictures of that event because we weren’t prepared for that.” This is an example of how Rene and Angelica are adapting and learning as they continue with their business.

Rene also related that sometimes they provide small presentations that they bring to the school two weeks before the planetarium experience, trying to get the kids excited about what they are going to see inside of the planetarium. Below: a group waiting to enter the dome.

What’s new on the IPS website?

If you haven’t been to the IPS website lately, be sure to check it out! (ips-planetarium.com) Wonderful changes are being made! On the main menu there is a new tab for “Get Involved” (contests, ways to share your talents, and how to apply for the American in Italy experience).

Also, be sure to look at the Resources tink for a new one for Portable Planetariums. Several new resources have been added, including two “do it yourself” construction guides.

Signing Off:

That is all for this time. I am sure there will be much more to share after IPS 2016 in Warsaw. I hope to see you there!
“Space Next looks fantastic on our dome.”
Peter Bak-Larsen, Chief Executive Officer,
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Two Weeks in Italy Report:
“Come Lo Sai?” means “How Do You Know?”

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“How do you know?” “Come lo sai?” This was the most useful teaching phrase I learned during my two weeks as an American planetarium operator working in Italy and being hosted by some truly wonderful communities of astronomers and educators. I had the privilege of being selected this year for “Two Weeks in Italy for an American Planetarium Operator,” and it was a remarkable, memorable, and deeply rewarding experience.

The worldwide community of planetarium operators and educators is a vibrant, international group, so it’s surprising that this enduring program (begun well over a decade ago) remains the only regular exchange program of its kind in our society.

The originator of the program is Loris Ramponi, one of the leading lights of the active, diverse astronomical community of Brescia, who partnered with Susan Button years ago to bring an American planetarium operator to this northern Italian town each year to teach in the portable planetarium of the Unione Astrofili Bresciani.

When a major funder stopped sponsoring the program, instead of simply letting the program die, to Loris’s great credit he reached out to others within the Italian planetarian community and expanded the program to encompass three Italian cities and two full weeks of teaching and cultural immersion. So it was that I was able to visit not only Brescia, but also Assisi and Gorizia.

We started in Rome

My trip started in Rome, where my wife and I stayed two nights and treated ourselves to a whirlwind self-guided tour of the essential sights: the Vatican Museums, St. Peter’s, the Forum, and the Parthenon. After a quick exposure to the hustle, grit, and history of Rome, we traveled by train to Assisi, in the heart of Umbria, where I met Simonetta Ercoi and Luca di Bitonto, two members of the group Starlight-A Handy Planetarium, who would be our guides and liaisons for the next few days.

Simonetta, a retired teacher, runs Starlight along with her colleagues and former students Luca and Abdelhalim El Hilali. Starlight is an educational outreach program that conducts student and teacher workshops throughout Assisi, Perugia, and surrounding towns. They had arranged for me to teach at II Liceo Scientifico di Assisi, near the top of the hill in the center of Assisi, where I presented my lesson, “How We Know What We Know About the Stars” to high school and junior high students. All told during my time in Italy, I presented this lesson 21 times to a total of 480 students.

Astronomy is about the question

As I explained to the students, as a historian of astronomy I believe astronomy is more than simply telling people about the nature of stars, planets, and the universe. Rather, astronomy is about answering one question: “How do we know?” Take the stars, for instance. My lesson was built around making naked-eye observations of the stars and exploring how we get from those simple observations to our modern view of the stars. How do we know how far away the stars are, what they’re made of, or how they evolve?

Using a pair of LED Harry Potter wands “stolen” from my children for this trip and a student-constructed HR-diagram plotting shoe size against height, we walked through some pieces of the history of stellar astronomy. My first evening in Assisi I also presented a teacher’s workshop on using the history of astronomy to teach about the nature and practice of science. (If you’re interested in the complete texts of these lessons, please contact me at scase@olivet.edu.)

The mornings in Assisi were filled with lessons, but in the evenings we had the chance to see the city itself, as well as neighboring Perugia. I think the hills of Umbria and the narrow, winding streets of medieval towns like Assisi are what many people envision when they imagine Italy.

The agriturismo where Simonetta had arranged lodgings for us had a perfect view of Assisi set on its hill, which was a lovely sight each morning. The town itself seemed like a sculpture, with picturesque streets and churches rich in history. Perugia likewise was steeped in layers of history (with ruins that were Etruscan, as opposed to Roman), and we felt privileged to learn these towns from locals who knew them inside and out.

After three days we said goodbye to our Umbrian hosts and hopped a series of trains to Brescia, in Lombardy, north-central Italy. Brescia was a more sprawling, industrial town, but it still had an ancient core and layers of history, including a very impressive astronomical clock at the town center.

Stephen Case is the director of the Strickler Planetarium on the campus of Olivet Nazarene University, where he teaches astronomy, physics, and in the university honors program. His PhD is in the history and philosophy of science from the University of Notre Dame, and his book on nineteenth-century stellar astronomy is forthcoming from University of Pittsburgh Press.
Impressed by outreach in Brescia

In Brescia I was impressed by the varied and manifold outreach programs of the Unione Astrofili Bresciani, which included a portable planetarium and lessons presented in schools, a public observatory in the castle at the center of the city, and the very active Osservatorio Serafino Zani on a mountain above the neighboring town of Lumezzane.

In the mornings I taught at the Liceo Scientifico Calini using the club’s Starlab planetarium, and one evening I was a speaker at the annual meeting between the club and the mayor of Lumezzane, during which members related the activities of their local observatory and I spoke briefly about my own work.

One of the most impressive things in Italy was the close association between amateur astronomy and educational outreach. In Assisi and especially Brescia and Gorizia, amateur astronomers did important work detecting and tracking near-Earth asteroids in well-equipped observatories while simultaneously pursuing educational outreach.

As just one example of this, both of the observatories in Gorizia and Brescia had state-of-the-art lecture halls in addition to their telescopes. It is to the credit of astronomy education among amateurs in Italy that this cultural exchange program is supported and hosted not by schools or institutions but rather by active, enthusiastic amateur associations.

Next stop: Gorizia

After our stay in Brescia, our next stop was the city of Gorizia, in Friuli on the northeastern border of Italy. Here we were hosted by Luciano Bittesini, president of the Circolo Culturale Astronomico di Farra D’Isonzo. I was originally scheduled to teach three days in Gorizia, but an unexpected cancellation meant that I had a bit of downtime and taught only a single day. After the busy schedule in Assisi and Brescia, this was welcome, and our hosts showed us around the surrounding region, which included crossing over the border into Slovenia, seeing the Roman ruins in Aquileia and the fortress town of Palmanova, and venturing to Trieste on the Adriatic coast.

My day of lessons in Gorizia were given at the observatory, which, in addition to two large telescopes and a lecture hall, has a permanent digital planetarium. The final evening culminated with a public talk on ancient Greek ideas regarding the nature of the stars to an audience of about forty.

In attendance for this lecture were several students from the United World College (Adriatic Campus), a two-year program that brings together students from all over the world. It was quite wonderful to end the evening and my time teaching in Italy under the stars on the roof of an observatory, discussing ancient and modern astronomy with enthusiastic students from Syria, Yemen, Scotland, and Hungary!

Luckily I didn’t have to return directly from this exhausting, exhilarating trip to teaching and the final weeks of the semester at my university. My wife and I were able to squeeze in three nights on our own in Venice before we departed Italy, and this city was just as magical as I imagined it would be.

Murphy’s Law strikes

Of course, the day before we flew back to the states was a Friday, and that morning I received an email from my secretary that one of the projectors in our planetarium was on the fritz and could I please get it fixed as soon as I returned, as we had a large school group scheduled for Monday morning.

“You两周 in Italy” is truly an amazing opportunity, and one that helps connect American planetarians with their counterparts in Europe as well as providing an opportunity to challenge and hone one’s pedagogy. (If you think you can explain something well, try doing it to various age groups who don’t speak English as a first language.)

I’d like to once again thank Susan Button, the International Planetarium Society; and our wonderful hosts in Italy for this incredible experience. If you’re considering applying, I would very, very strongly urge you to do so. It’s certainly a lot of work, but it is well worth it. You’ll experience all the culture and history of Italy from a unique perspective, in addition to the privilege of meeting other astronomy educators and teaching enthusiastic international students.

The other piece of advice that I’d give is to be flexible. You’ll go with a lesson in hand, but be ready to teach it to a variety of age levels who have a variety of different levels of comfort with English. I found that the English comprehension varied from class to class, but the students were uniformly excited about an opportunity to dialogue and practice in it (which felt a little unfair to them, as I knew so little Italian to speak in return).

You’ll also teach in a variety of settings, from no planetarium to a portable planetarium to a permanent planetarium. Finally, your lesson should also be flexible in length. Most lessons lasted an hour, but in some places

(Continues on page 80)
was equipped on board the ship in 2003. It is small: the diameter of the dome is 4 m and seats 20 people. The projector is a Moscow point Eline-K. The attendance at the planetarium in winter is limited because of the cold, but it is very comfortable in the hot weather there in summer time. Today the planetarium and the ship itself are in danger of closing. (See story on page 30.)

Moscow. The XL Academic Readings on Cosmonautics took place on 26-29 January. Planetarians of Astrakhan, Bryansk, Nizhny Novgorod, and others took part because the current conference of the Association of Cosmonautics Museums took place there in the section Cosmonautics and Culture. The conference paid much attention to the fate of the ship Cosmonaut Viktor Patzaev and it was decided to protect it.

Baikonur. The group of planetarians and teachers made an excursion to the space center Baikonur on 17-20 March. They visited the space rocket and assembling proof-of-concept complexes, museums, and also the city of Baikonur. On 19 March they watched the launch of the space-ship Soyuz TMA-20M.

Take my challenge
Finally, I’d like to challenge my colleagues in the United States to help set up a reciprocal program. It seems a shame there’s no counterpart to this long-standing Italian opportunity. Surely we could pool our resources and bring a planetarian from abroad to teach and share their experience in the United States, perhaps in conjunction with one of our regional conferences.

I tentatively (and with very little reflection on the actual practicalities) propose something like an American Planetariums International Ambassadors Program, which would bring an international planetarian to visit and teach at various planetariums in the United States. If you’re interested in discussing ways to make this happen, please feel free to contact me. 

Italian astronomy resources:
Star*Light (Perugia): www.starlightgroup.it
Unione Astrofili Bresciani (Brescia): www.astrofilibresciani.it
Circolo Culturale Astronomico di Farra D’Isonzo (Gorizia): www.ccaf.it

I had to extend the material to cover a two-hour period. (See my comment above about honing one’s pedagogy!)

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Statistics, Data Mining, and Machine Learning in Astronomy
Željko Ivezic, Andrew J. Connolly, Jacob T. VanderPlas and Alexander Gray, Princeton University Press, 2014

Reviewed by Michael Lynch, Lecturer, Games and Simulation, Arts and Sciences, Rensselaer Polytechnic Institute, Troy, New York, USA.

This is a substantial work that can be of value to students and scientists interested in mining the vast amount of astronomical data collected to date (satellite and space probe telemetry, CCD images, radio telescope signals, and much else).

While in a sense an “introductory” book (and a textbook for graduate students and upper-level undergraduates), it is nevertheless a comprehensive examination of a wealth of statistical techniques for data mining, Python programming examples, and machine learning algorithms, all in the service of making sense of the close to a petabyte (1015 bytes) volume of astronomical data available for analysis.

The first section of the text (two chapters) provides an essential overview of the material as well as helping the student or researcher get set up for the very large analysis work to follow.

The second section (three chapters) forms an intense refresher course in statistics, but by itself is dense and assumes considerable prior knowledge. These chapters are also specialized, in that they cover distribution statistics far beyond the standard Gaussian distribution, plus Bayesian statistical inference.

The essence of data mining is this: to extract, from a mountain of fuzzy and noisy data, whatever patterns, clusters, relationships, etc. that are “latent” in the data. As such, this is an exploratory phase of science: from the relationships that are uncovered (or discovered), it may then be possible to formulate coherent and testable models and theories.

In a nutshell, there is a suspected “true” function between one or more independent variables and one or more dependent variables. The authors call this function $f(x)$ (in traditional statistics, this is generally called $f(x)$, and the data-derived function approximated through analysis of observed data, the authors call $f(x)$ and is traditionally called “$f$-hat” $\hat{f}$). This is the central problem that the remainder of the text addresses.

The third and largest section of the text explores a large catalog of techniques toward this end, beginning with more conventional methods and moving to classification techniques via forms of machine learning.

The classification chapter is exceptionally thorough (and 100 pages in length), and easily forms the most valuable part of the book. This section closes with another very useful chapter on time series analysis.

The last section of the text, the appendices, covers topics like scientific computing with Python, machine learning with the AstroML library, and several other supporting topics. As with much of this text, these materials do require some prior knowledge, for example, of the Python programming language. This is hardly a problem with Python in particular, as there is an immense body of tutorial material on the Internet, and the Python language is itself, of course, free to download (www.python.org).

All in all, this is a well-prepared introduction to this material. If there is a place where it may be thought to come up short, is that it is less of a comprehensive handbook and more of a textbook. But if data mining and machine learning fall within your interest area, this text deserves a place on your shelf.

The New Cosmos: Answering Astronomy’s Big Questions
David J. Eicher (author), Alex Filippenko (foreword), Cambridge University Press, 2016

Reviewed by Richard Dreiser, The University of Chicago Yerkes Observatory, Williams Bay, Wisconsin USA.


Carl Sagan’s spaceship of the imagination resonated with people of all ages and understandably helped launch many careers in astronomy and astrophysics (including Eicher’s). Tyson’s version certainly helped launch more, and David Eicher’s The New Cosmos quickly sold out, apparently the most popular science book Amazon has ever offered. (Who knew?)

Carl Sagan’s Cosmos had a profound effect on David Eicher, and he not unreasonably must have believed it and Neil deGrasse Tyson’s version (once the cosmic dust had settled) must need improvements. Hence The New Cosmos.

The last couple of years have seen an astonishing diversity of insights into nearly every conceivable aspect of astronomy, from the evidence suggesting water on Mars to thousands of exoplanets. We’ve seen close-up details of comets and asteroids and Pluto and its moons. The enormous Chelyabinsk meteor exploded over Siberia, filmed by many hundreds of Russians. Nearly unimaginable forces are now routinely brought to our attention: galaxy Pictor A is spewing an enormous jet of particles traveling at nearly the speed of light into intergalactic space.

The New Cosmos is a splendid read and delivers, in easily-digested

(Continues on page 84)
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Sharp, bright, and in the right place at the right time. Just as we hope you will be on August 21, 2017. Oh, and good luck with that weather!

For Planetarium Educators:
GOTO’s “Greatest Eclipse Hits”
From its extensive library of solar eclipse fulldome videos, still photos, and movies GOTO INC has assembled a deeply discounted set of solar eclipse resources to help planetarians teach America about the upcoming eclipse. This set of materials can be used to create your own show or to accompany a live lecture in your dome. Please go to https://www.domenavi.com/en/SearchResults.php?search_word=2017+USA to preview or purchase the materials. Or contact Yuka Sato at <y0807sat@goto.co.jp> for more eclipse clip information.

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chapters, exactly the kind of increased information the public, inspired by both *Cosmos* programs and almost daily fascinating astronomical press releases and images, might desire. I’m personally looking forward to seeing *The New Cosmos* in a lower-priced paper cover edition. I swear it too will be a best-seller.

**The New Moon: Water, Exploration, and Future Habitation**

Arlen Crotts, Cambridge University Press, 2014
Reviewed by Francine Jackson, University of Rhode Island Planetarium, Providence, Rhode Island, USA

I didn’t realize when I started to read this book how much information about our moon could fit inside one volume. *The New Moon* is full of the history, from the beginning of the Space Race to JFK’s “We choose to go to the Moon” speech, to everything having to do with our nearest celestial neighbor.

Author Crotts goes back to the days of von Braun, his work with rockets, and his dream of using them for more than destruction. From there we follow both cosmonauts and astronauts through the grueling push to be the first to place footprints on the moon. We know the U.S. succeeded, but, do you know exactly what happened on each successful Apollo mission?

There is a lot of dialogue during these journeys, between the astronauts (remember Cernan’s and Schmitt’s rendition of “Strolling Through the Park One Day”?), and mission control. The author treats us to little-known information and images taken by those who walked there, like Alan Shepard’s series of photos of the Earth, Venus, and Mars from within the lunar module.

Crotts goes through the history of every lunar craft ever to orbit the moon or land on its surface, with the percentage of the GDP for each country, and the amount per capita spent for every agency—very important to some of us who don’t believe enough is spent on space research.

We have a chapter concerning the moon’s importance to us, and another on why we abandoned it, useful for those of us who can’t understand why this happened.

Crotts reminds us of the potentially staggering amount of water the moon appears to contain, along with other elements necessary for us down here. He also has created varied approaches to lunar housing, even noting the quality of regolith as a potential building material.

Every chapter has one of the most comprehensive sets of notes I have seen. Normally, I kind of shrug them off as just an explanation of a sentence or a reference to something mentioned. In this case, many of the notes are as interesting as the book itself, adding related poetry, more astronaut dialogue, or a more complete explanation of the text. Don’t bypass this important section of each chapter.

There is a tone of discouragement in this book, as the reader can almost hear the lament of the author, who believes the moon should be a much more important part of our daily lives, as do many of us. He makes a very strong argument for our necessity to return there permanently. We really should.

*The New Moon* is a real compendium of everything you should know about the moon. Each chapter is unique, and the final product gives us more information on our neighbor than I could believe ever could fit into one book. This book is fairly long, but, take it chapter by chapter, savor every one, as with each reading I was amazed how much I didn’t know about the moon. You will, too. Enjoy.

**Bright Star, Night Star**

Reviewed by April Whitt, Fernbank Science Center, Atlanta, Georgia, USA

Here’s a little paperback book described on the back cover as “The starry skies—with a little science—for ages 4-10.” The back cover distills the “little science” nicely, and the rhyming text is a delight to read aloud to children.

Premio Press specializes in multicultural fun. It is refreshing to see a book with images of children of different cultures, reading books and observing the real night sky. While several self-published books I’ve seen have been difficult to read, given their design and type colors, this one is great.

Another plus is the “online secrets”: information at the publisher’s web site with questions and challenges (“Can you find six U.S. states named in the book?”) for each volume.

If used with younger children, I would suggest asking them what is happening in each of the pictures as the story unfolds and giving them time to pore over some of the more intricate illustrations.

I have only two concerns: the grammar on page 2, and the list of seemingly random solar system objects on page 4.

Check out this book as a possibility for a gift shop.
Explore the Earth, Sun, and Moon systems with Annie, Cy, their dog Armstrong, and a wise-cracking starship computer. The Accidental Astronauts is a space adventure for all ages, designed to cover astronomy curriculum subjects in the low-to-mid elementary school levels.

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Johan Sköld is new Sciss CEO

Johan Sköld, former COO, has been appointed CEO and will succeed Staffan Klashed, who remains in a strategic role on Sciss’s board of directors.

Johan joined Sciss in 2006, and has since had the roles of sales director, acting CEO, and COO. Over the last decade he has played a large part in the transformation that Sciss has made since the company was founded.

Staffan Klashed and colleague Per Hemmingsson co-founded Sciss in 2004, and Staffan has since led the company as CEO through its growth and development. Sciss entered the planetarium market by introducing the Uniview software to the industry, a data visualization technology with real-time computer graphics and interactive components.

Together with New York’s American Museum of Natural History and Digital Universe, Uniview changed the planetarium landscape and became the breakthrough for digital planetariums worldwide.

Today, Sciss is a planetarium systems integrator that designs and builds complete solutions for dome theaters. Our scope has grown to include hardware, display systems, software, and the multiple elements that go into the design of modern, digital planetariums.

Waxing New

Museum Alliance helps spread summer education

You’ve probably heard about some of the fascinating missions and science happening at NASA, but wouldn’t it be great if you could see it in person? You can!

Every day, hundreds of museums, planetariums, observatories, libraries, and other institutions participating in NASA’s Museum Alliance offer exhibits, planetarium shows and events featuring NASA science, technology and engineering. As the school year comes to a close, you can keep students—and learners of all ages—engaged by visiting your local informal education institutions.

Not sure where to start? Use the Museum Alliance’s "Map of Members" to find destinations near you or explore the dynamic “Events Near Me” map, which lets you search by date to find the latest offerings.

For example, this month you could check out the new exhibits Out of this World: A Space Adventure at The Living Arts & Science Center in Lexington, Kentucky, or the Discover NASA traveling exhibition at the Auburn Public Library in Maine. You could experience Intergalactic: A Space Odyssey in the digital dome theater of Mid-America Science Museum in Hot Springs, Arkansas.

Every year, more visits are made to U.S. museums—more than 850 million—than to all major sporting events and theme parks combined. Americans love their museums—get out there and see why!

At a museum, science center, library, camp, planetarium, or other informal education institution? Learn how you can join the more than 700 organizations participating in NASA’s Museum Alliance at informal.jpl.nasa.gov/museum/About/Application.

—Amelia Chapman, STEM Informal Education Specialist, NASA

Having fun with exploration in Washington DC

I was at the Smithsonian’s National Air & Space Museum on April 9 as part of their Exploring the Universe Day. I had the honor of presenting the 10:30 am Sky Tonight show to a full house. Sean O’Brien (NASM planetarium technician) operated the console and I strolled through the theater with mic and pointer.

Some of the audience members used my tactile constellation images to follow along during the show. After the planetarium show, I did a book signing (for Everyone’s Universe). And, after that, I changed into costume and became astronomer Maria Mitchell for the afternoon; talking to visitors in the exhibit halls about the night sky in the mid-late 1800s. It was a five-star day in DC!

—Noreen Grice

If you could see the Earth illuminated when you were in a place as dark as night, it would look to you more splendid than the moon.

—Galileo Galilei, Dialogue Concerning the Two Chief World Systems, 1632 spacequotations.com
2016 International Year of Pulses
7 June. The Eugenides Planetarium, Athens, Greece, celebrates its 50th anniversary. The event coincides with the Eugenides Foundation’s 60th birthday.


15-17 June. IPS Fulldome Festival Brno 2016, Brno Observatory and Planetarium, Kravi hora 2, Brno, Czech Republic. The festival is jointly organized by the International Planetarium Society. Contact: Jiri Dusek, director@hvezdarna.cz; www.fulldomefestivalbrno.com

18-19 June. International Planetarium Society Council Meeting, Warsaw, Poland.

19-25 June. Revolve, 23rd International Planetarium Society Conference, Heavens of Copernicus Planetarium, Copernicus Science Center, Warsaw, Poland. Contact: info@ips2016.org; Monika Malinowsky, monika@ips2016.org; Maciej Ligowski, maciej.ligowski@kopernik.org.pl

21 June. Summer Solstice; Solstice2016 will celebrate around the world. Contact at info@solstice2016.com; www.solstice2016.com

30 June. International Asteroid Day. www.asteroidday.org


11-15 July. 21st European Association for Astronomy Education (EAAE) Summer School for Teachers under the theme “Astronomy at our Schools.” Poster and short presentation session, general assembly (15 July), Câmara Municipal de Loulé, Ciência Viva, Loulé, Algarve, Portugal. www.eaae-astronomy.org


27 July. Bowen Technovation Pre-MAPS STEAM Exhibit Design Workshop, Hilton Garden Inn, Waldorf, Maryland. bowentechnovation.com/Bowen-Pre-MAPS-Exhibit-Design-WorkshopJuly-27

27-30 July. Middle Atlantic Planetarium Society (MAPS), Annual Conference, James E. Richardson Science Center, St. Charles County High School, Waldorf, Maryland, USA. Contact: Patty Seaton, pxts13@yahoo.com; www.mapsplanetarium.org

9-11 August. Fiske Full Dome Film Festival, Fiske Planetarium-University of Colorado Boulder, Boulder, Colorado, USA. Contact: Thor Metzinger, thormetzinger@gmail.com

10-12 August. Live Interactive Planetarian Symposium (LIPS), Spitz Inc., Chadds Ford (near Philadelphia), Pennsylvania, USA. Contact: jtowne@spitzinc.com; cseale@spitzinc.com; LIPSymposium.org

15 September. Deadline for the applicants of “A Week in Italy for an American Planetarium Operator,” in collaboration with IPS Portable Planetarium Committee. www.astrofilibresciani.it/Planetarii/Week_in_Italy/Week_Italy.htm or ips-planetariumsite-ym.com/?page=italy

16-20 September. Association of Brazilian Planetariums (ABP), 21st Annual Meeting, CEU Foundation Planetarium, Brotas, São Paulo state, Brasil. www.planetarios.org.br

21-23 September. Digistar Users Group, conference, planetarium at University of Texas at Arlington, Texas. Contact: planetarium@uta.edu; 817-272-1183; www.uta.edu/planetarium; www.facebook.com/utaplanetarium

23-25 September. British Association of Planetaria (BAP), annual meeting, Bristol Science Center Planetarium, United Kingdom. Contact: BAP President Mark Watson, m.watson.bap@gmail.com; www.planetaria.org.uk; bapconference.org.uk


19-22 October. Great Lakes Planetarium Association, GLPA Conference, Longway Planetarium, Flint, Michigan, USA. www.glpaweb.org; contact Todd Slisher and/or Jeff Stark at tslisher@sloanlongway.org; jstark@sloanlongway.org (A GLPSA workshop will proceed on October 18)

21-23 October. Small digital planetarium workshop, Jardin des Sciences, Strasbourg, France. Contact lionel.ruiuz@live.fr


16-18 December. Small digital planetarium workshop, Marseille Planetarium, Marseille, France. Contact: lionel.ruiuz@live.fr

31 December. Deadline for entries to “Page of Stars” organized by IPS Portable Planetarium Committee in collaboration with Serafini Zani Astronomical Observatory. Contact: Susan Reynolds Button, sbuttonq2c@gmail.com; www.ips-planetarium.org/?page=pagessofstars

2017 International Year of Sustainable Tourism for Development

21 August. Total solar eclipse (USA).


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 at the IPS Calendar of Events at www.ips-planetarium.org How to organize an eco-friendly planetarium conference: www.scienzagiovanissimi.it/best-practices
At a Great Lakes Planetarium Association meeting several years ago, one of the delegates mentioned a list he’d made that included the items “grocery list, home chores, fix moon” and, for some reason, had jotted the museum’s phone number on the list as well.

And as often happens with lists on paper, he lost the note. Later that day, someone phoned the planetarium and asked to bring the note by, because, “It looks pretty serious.”

At the same meeting, one of the delegates told about running the planetarium program Zubeneleguubi’s Magic Sky, a program for young visitors. The main character refers to himself as “Zuby,” and the delegate heard some snickering during the show. He asked afterward what was so funny, and one visitor told him that the word “zuby” is Arabic slang for “daddy parts.”

Sue Batson from near Pittsburgh, Pennsylvania described an “eclipse bake sale/gift sale” her students held to raise money for their astronomy club. They made enough money to show a profit, or be “in the black.” Which is amusing enough for an eclipse event, but when she told her students they were in the black, they just looked at her blankly. In their electronic existence, they had no concept of red ink or black ink.

Talking with astronauts. Over.

Mitch Lumen’s planetarium in Indiana hosted an event for students to speak with astronauts aboard the International Space Station. Students practiced asking their questions before the event, concluding each question with the word, “Over” so the astronaut would know that was the end of the question. After his presentation about the event, Mitch asked if there were any questions from the audience. One wag raised a hand and asked, “What’s the best thing you learned from this? Over!”

Staff from the old museum in Grand Rapids recalled a problem with the huge whale skeleton that hung in the lobby of the old building. Visitors standing on the upper balcony would throw pennies onto the tail section of the whale.

The staff tried posting a sign “Don’t throw pennies,” but the pennies continued to accumulate. Staff decided to try a sign, or be “in the black.” Which is amusing enough for an eclipse event, but when she told her students they were in the black, they just looked at her blankly. In their electronic existence, they had no concept of red ink or black ink.

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