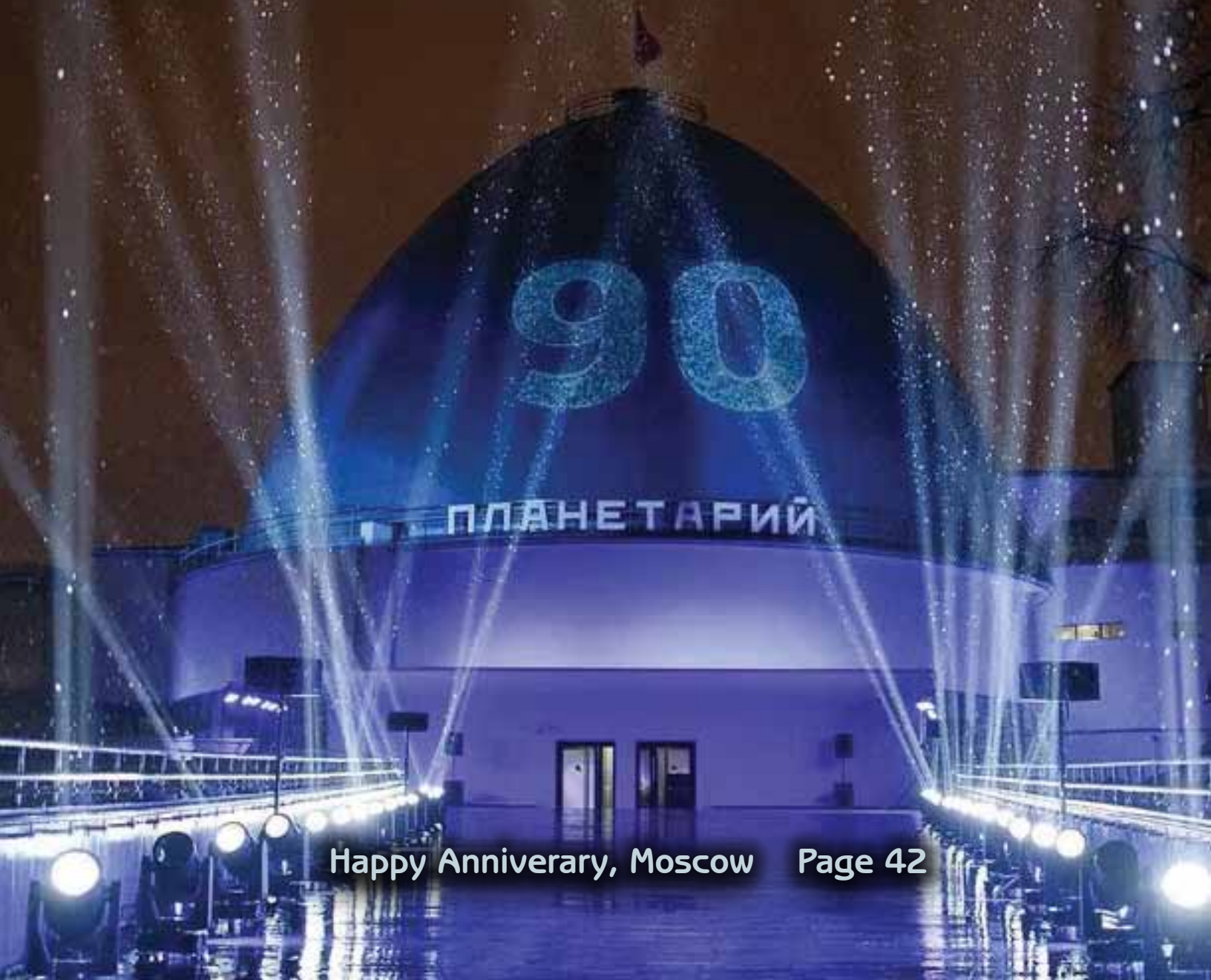


Vol. 49, No. 1

March 2020

PLANETARIAN

Journal of the International Planetarium Society



Happy Anniverary, Moscow Page 42

Make a splash in your planetarium with a show your audiences will love!

WHALE Super Highway

FROM THE PRODUCER OF *NINGALOO: AUSTRALIA'S OTHER GREAT REEF*



Follow humpback whales and blue pygmy whales on their epic migration down the coast of Western Australia to the freezing waters of Antarctica. **Whale Super Highway** tells an emotional tale that will appeal to all ages, while underscoring how much we still have to learn, and how critical it is to protect our oceans.



**FILMED WITH A FISHEYE LENS,
SPECIFICALLY FOR FULLDOME!**



Book *Whale Super Highway* today!

Tina Ratterman, BIG & Digital, LLC

tratterman@biganddigital.com • 1-702-932-4045

Watch the trailer and learn more at biganddigital.com.

NOW AVAILABLE IN 180-FULLDOME 2D • 30 FPS • 4K RUN TIMES: 45 MINUTES AND 27 MINUTES

Available direct through BIG & Digital and Evans & Sutherland and Sky-Skan.



Executive Editor

Sharon Shanks
484 Canterbury Ln
Boardman, Ohio 44512 USA
+1 330-783-9341
sharon.shanks@gmail.com

Webmaster

Alan Gould
Lawrence Hall of Science Planetarium
University of California
Berkeley CA 94720-5200 USA
adgould@comcast.net

Advertising Coordinator

Dale Smith
(See Publications Committee on page 3)

Membership

Individual: \$65 one year; \$100 two years
Institutional: \$250 first year; \$125 annual renewal
Library Subscriptions: \$50 one year; \$90 two years
All amounts in US currency
Direct membership requests and changes of
address to the Treasurer/Membership Chairman

Printed Back Issues of Planetarian

IPS Back Publications Repository
maintained by the Treasurer/Membership Chair
(See contact information on next page)

Final Deadlines

March: January 21
June: April 21
September: July 21
December: October 21

Associate Editors

Book Reviews
Calendar
Cartoons
Classroom education

Data to Dome
Education Committee
Humor

Immersive Media
International News
Live interactive programs
Mobile news
Planetarium design/operations
Sound advice
Southern Hemisphere
History/Years ago

April S. Whitt
Loris Ramponi
Alexandre Cherman
Mark Percy and the
Classdome Cadre
Mark SubbaRao
Jeanne Bishop
April S. Whitt
Ron Walker
Carolyn Collins Petersen
Lars Petersen
Karrie Berglund
Susan Reynolds Button
Tim Barry
Jeff Bowen
Haritina Mogoşanu
Tom Callen
Ron Walker

On the Cover

Congratulations to the Moscow Planetarium
on the occasion of its 90th anniversary!
Read more about its celebration in Interna-
tional News on page 42. Photo courtesy of the
press service of the Moscow Planetarium.

International Planetarium Society home page:
www.ips-planetarium.org

Planetarian home page:
www.ips-planetarium.org/page/plntrn



www.facebook.com/InternationalPlanetariumSociety
twitter.com/IPS_Planetarium

PLANETARIAN

March 2020
Vol 49 No 1

Articles

- 10 Letter to the Editor: The lights are on at the Schreder
Planetarium Jack Schreder
- 10 Nominations now being taken for officer
positions Martin George
- 12 Chile: ACEAP ambassadors bring the big science back
to the public Amy Barraclough, Carla Johns
- 16 A perfect match: Kindred spirits share the stars,
education through professional development exchange
John Meader
- 20 Bob and Mark's excellent eclipse adventure Mark Percy
- 24 The future of fulldome film distribution Michael Daut
- 64 The Data to Dome workshop at Colgate University
Joshua Finnell, Joe Eakin
- 54 How we do it: Step-up DC-DC converter for Losmandy
Germini II Adam Thanz
- 70 Tributes: Ronald Maddison, Heather Couper,
Larry Krozel, Antonio Cornejo, John Campbell Brown

Index of Advertisers

American Museum of Natural History	29
Ash Enterprises.....	33
Audio Visual Imagineering	55
BIG & Digital.....	inside front cover
Bowen Technovation	47
California Academy of Sciences	11
Clark Planetarium.....	69
Digitalis Education Solutions	41
Evans & Sutherland	23, 27, 36-37,
.....	outside back cover
GOTO Inc.	inside back cover
IPS 2020/Edmonton.....	57
Metaspace.....	45
Mirage 3D.....	9
Ohira Tech/Megastar	7
RSACosmos	5
Spitz, Inc.....	31, 59
Spitz Creative Media.....	15, 19
You Can Do Astronomy.....	58
ZEISS.....	43

PLANETARIAN

March 2020

Vol 49 No 1

Columns

- 6 In Front of the Console: The importance of live and in person Sharon Shanks
- 8 President's Message: Getting excited about Edmonton Mark SubbaRao
- 24 IMERSA Matters: Content distribution in a world without standards Carolyn Collins Petersen
- 32 Seeking What Works: How gender affects learning Jeanne Bishop
- 34 From the Classdome: A classdome cadre takes over Mark Percy
- 38 International News Lars Petersen
- 48 Tales from Dome Under: What goes up, must come down Tom Callen
- 51 41 South: A tough question with a miraculous answer Haritina Mogoşanu
- 52 LIP Service: New year, new energy Karrie Berglund
- 56 Mobile News: Dome adaptations for hot/bright climates Susan Reynolds Button
- 60 Book Reviews April Whitt
Time of our Lives: Sundials of the Adler Planetarium
The Space Book: From the Beginning to the End of Time
Apollo's Muse: The Moon in the Age of Photography
Touch the Stars
- 61 PARTYcles Alex Cherman
- 62 Sound Advice Jeff Bowen
- 64 Data to Dome Mark SubbaRao
- 67 A Different Point of View: Ron Walker
- 71 Calendar of Events Loris Ramponi
- 72 Last Light: "How to make it look easy" April Whitt

Officers



President
Mark SubbaRao

Adler Planetarium
1300 South Lake Shore Drive
Chicago, Illinois 60605 USA
+1 312-294-0348
msubbarao@adlerplanetarium.org



Past President
Shawn Laatsch

Emera Astronomy Center
167 Rangeley Road
Orono, Maine 04469 USA
shawn.laatsch@gmail.com



President Elect
Kaoru Kimura

Japan Science Foundation/Science Museum
2-1 Kitanomaru-koen, Chiyoda-ku,
Tokyo, Japan 102-0091
+81 3-3212-8506
Fax: +81 3 3212 8443
kaoru13ican@gmail.com



Executive Secretary
Patty Seaton

Howard B. Owens Science Center
9601 Greenbelt Road
Lanham, Maryland 20706 USA
+1 301-906-5990
pxts13@yahoo.com



Treasurer
Ann Bragg

Anderson Hancock Planetarium
Marietta College
215 Fifth Street
Marietta, Ohio 45750 USA
+1 740-376-4589
ann.bragg@marietta.edu



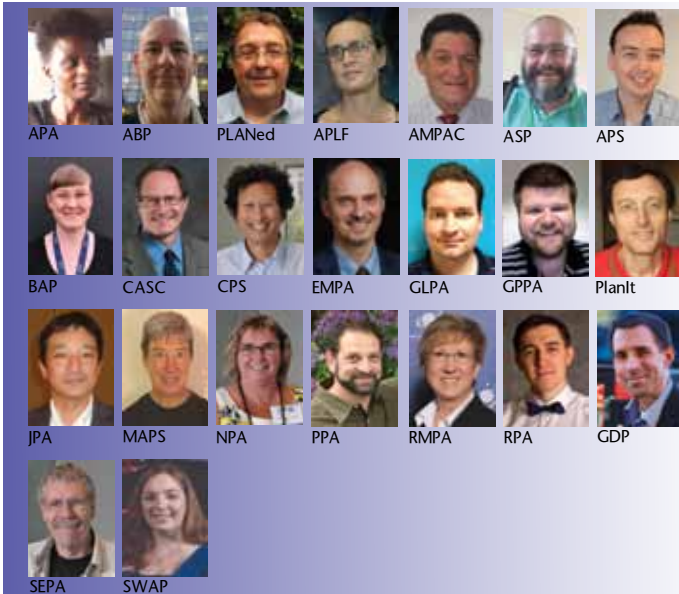
Director of Operations
Kristen Lepine Dos Santos

Managing Matters
411 Richmond Street East, Suite 200
Toronto, Ontario Canada M5A3S5
operations@ips-planetarium.org

Payments of membership fees and advertising invoices should be made to Ann Bragg

Membership fees also can be paid online on the IPS website

Affiliate Representatives



African Planetarium Association

APA
Susan Murabana Owen
The Travelling Telescope's Nairobi
Planetarium
105 Riverside Lane off Riverside Drive
Nairobi, Kenya
+254 722 218 267
smurabana@travellingtelescope.co.uk

Association of Brazilian Planetariums

ABP
Alexandre Cherman
Planetário do Rio de Janeiro
R. Vice-Governador
Rubens Berardo, 100
Rio de Janeiro RJ
Brazil 22451-070
+55 (21) 2088-0536 ext. 208
alexandre.cherman@
planetariodorio.com.br
www.planetarios.org.br
www.planetariodorio.com.br

Association of Dutch-Speaking Planetariums

PLANed
Jaap Vreeling
Nova informatie centrum
Science Park 904
1098 XH Amsterdam
+31 0 20 525 7480
+31 0 20 525 7484 fax
J.A.Vreeling@uva.nl
www.astronomie.nl

Association of French-Speaking Planetariums

APLF
Milene Wëndling
Université de Strasbourg
Jardin des Sciences
12 rue de l'Université
Strasbourg F-67000 France
+33 (0)3 68 85 05 32
+33 (0)3 68 85 04 88 fax
milene.wendling@unistra.fr
www.aplf-planetariums.org

Association of Mexican Planetariums

AMPAC
Ignacio Castro Pinal
Ave. San Bernabé, 723, Casa 7
San Jerónimo Lídice, C.P. 10200
México City, D.F. México
+52 (55) 5500 0562
+52 (55) 5500 0583 fax
icastrop@hotmail.com

Association of Spanish Planetariums

ASP
Javier Armentia
Planetario de Pamplona
Sancho Ramirez, 2
E-31008 Pamplona Navarra Spain
+34 948 260 004
+34 948 260 056
+34 948 261 919 fax
javarm@pamplonetario.org
www.planetarios.org

Australasian Planetarium Society

APS
Shane Hengst
University of New South Wales Physics
UNSW Australia
Sydney NSW 2052 Australia
+61 (2) 9385 4053
+61 (2) 9385 6060 fax
s.hengst@unsw.edu.au
www.aps-planetarium.org

British Association of Planetaria

BAP
Nina Cameron
Glasgow Science Centre
50 Pacific Quay
Glasgow, Scotland G51 1EA
+44 (0) 141 420 5010
nina.cameron@glasgowsciencecentre.org
www.planetaria.org.uk

Canadian Association of Science Centres

CASC
Frank Florian
TELUS World of Science
11211 142 Street NW
Edmonton, Alberta T5M 4A1 Canada
fflorian@twose.ca
www.canadiansciencecentres.ca

Chinese Planetarium Society

CPS
Jin Zhu
Beijing Planetarium
No. 138 Xizhimenwait Street
Beijing, 1000044
P.R. China
+86 10-5158-3311
+86 10-5158-3312 fax
jinzhu@bjp.org.cn

European/ Mediterranean Planetarium Association

EMP
Manos Kitsonas
Eugenides Planetarium
387 Syngrou Avenue
17564 P. Faliro
Athens, Greece
+30 210 946 9674
+30 210 9417372 fax
mak@eugenfound.edu.gr

Great Lakes Planetarium Association

GLPA
Mike Smail
Adler Planetarium
1300 S Lake Shore Drive
Chicago, Illinois 60612 USA
+1 312-294-0365
msmail@adlerplanetarium.org
www.glpa.org

Great Plains Planetarium Association

GPPA
Jack L. Northrup
Sci-Tech Instructional Facilitator
Omaha, Nebraska USA
jlnorthrup@fbx.com

Italian Association of Planetaria

IAP
Loris Ramponi
National Archive of Planetaria
c/o Centro Studi e Ricerche
Serafino Zani
via Bosca 24, C.P. 104
I 25066 Lumezzane (Brescia) Italy
+39 30 872 164
+39 30 872 545 fax
megrez58@gmail.com
osservatorio@serafinozani.it
www.planetari.org

Japan Planetarium Association

JPA
Sumito Hirota
Kawasaki Science Museum
7-1-2 Masugata, Tama-ku
Kawasaki, Kanagawa
214-0032 Japan
hirota@e23.jp
planetarium.jp

Middle Atlantic Planetarium Society

MAPS
April Whitt
Jim Cherry Memorial Planetarium
Fernbank Science Center
Atlanta, Georgia 30307 USA
april.whitt@dekalbschoolsga.org
www.mapsplanetarium.org

Nordic Planetarium Association

NPA
Aase Roland Jacobsen
The Science Museums
C.F. Moellers Alle 2
University of Aarhus
DK-8000 Aarhus C
Denmark
+45 87 15 54 15
aase.jacobsen@sm.au.dk

Pacific Planetarium Association

PPA
Benjamin Mendelsohn
West Valley Community College
14000 Fruitvale Avenue
Saratoga, California
95070-5698 USA
+1 408-741-4018
+1 408-741-4072 fax
Benjamin.Mendelsohn@wvm.edu
sites.csn.edu/planetarium/PPA

Rocky Mountain Planetarium Association

RMPA
Michele Wistisen
Casper Planetarium
904 North Poplar Street
Casper, Wyoming
82601 USA
+1 307-577-0310
michele_wistisen@natronaschools.org

Russian Planetariums Association

RPA
Yaroslav Gubchenko
FullDome Film Society
PO Box 103
60310 Nizhny Novgorod, Russia
gubchenko@fulldomefilm.org
www.apr.planetariums.ru

Society of the German-Speaking Planetariums

GDP
Björn Voss
LWL-Museum für Naturkunde
Westphalian State Museum
of Natural History
Sentruper Str. 285
48161 Münster Germany
+49-251-591-6026
+49-251-591-6098 fax
bjoern.voss@lwl.org
www.gdp-planetarium.org

Southeastern Planetarium Association

SEPA
John Hare
Ash Enterprises
29 Riverside Drive, Apt 402
Cocoa, Florida 32922 USA
+1 941 730 3434
johnhare@earthlink.net
www.sepadomes.org

Southwestern Association of Planetariums

SWAP
Sarah Twidel
Noble Planetarium
Fort Worth Museum of Science and History
1600 Gendy Street
Fort Worth, Texas 76107 USA
(817) 255 - 9409
stwidal@fwvmsh.org
www.swapskies.org

Standing Committees

Awards

Manos Kitsonas, Chair
Eugenides Planetarium
387 Syngrou Avenue
17564 P. Faliro
Athens, Greece
+30 210 946 9674
+30 210 941 7372 fax
mak@eugenfound.edu.gr

Conference

Current Officers
Upcoming conference host, past conference host, any IPS member appointed by the president

Conference Host-2020

Alan Nursall, President and CEO
Frank Florian, Director, Planetarium and Space Sciences
Cathy Barton, Executive Assistant
11211 – 142 Street NW
Edmonton, Alberta, Canada T5M 4A1
anursall@twose.ca
fflorian@twose.ca
cbarton@twose.ca

Elections

Martin George, Chair
Launceston Planetarium
Queen Victoria Museum
Wellington Street
Launceston Tasmania 7250
Australia
+61 3 6323 3777
+61 3 6323 3776 fax
Martin.George@qvmag.tas.gov.au

Equity, Diversity and Inclusion

Karla Peregrina, Chair
Cancun Planetarium Ka' Yok'
Consejo Quintanarroense de Ciencia y Tecnología
Av. Palenque s/n S.M.21Mz. 5 CP 77505
Cancún, Quintana Roo, México
+1 52 (998) 883 95 57
+1 52 (998) 201 15 18

Finance

Current Officers

Membership

Mike Murray, Chair
Delta College Planetarium
100 Center Avenue
Bay City, Michigan 48708 USA
+1 989-667-2270
mikemurray@delta.edu

Publications

Dale W. Smith, Chair
BGSU Planetarium
104 Overman Hall
Physics & Astronomy Department
Bowling Green State University
Bowling Green, Ohio 43403 USA
+1 419-372-8666
+1 419-372-9938 fax
dwsmith@bgsu.edu

IPS Permanent Mailing Address

International Planetarium Society
c/o Ann Bragg, Treasurer
Marietta College
215 Fifth Street
Marietta, Ohio 45750 USA

IPS Web Site:
www.ips-planetarium.org

Please notify the Editor and Secretary of any changes on these two pages.

Contact the Treasurer/Membership Chair for individual member address changes and general circulation and billing questions. Addresses also may be changed online on the IPS Web Site.

Professional Partners



Ad Hoc Committees/Task Forces/Working Groups

Armand Spitz

Planetarium Education Fund
Finance Committee

Education

Jeanne E. Bishop
Planetarium Director
Parkside Administration Building
24525 Hilliard Road
Westlake, Ohio 44145 USA
+1 440-871-5293
+1 440-835-5572 fax
jeanneebishop@wowway.com
www.glpaweb.org
Mail address:
3180 Oakwood Lane
Westlake, Ohio 44145 USA

Emerging Communities

Dave Weinrich
5250 State Road 35 S
Nelson, Wisconsin 54756 USA
dave.l.weinrich@gmail.com

History

John Hare, IPS Historian
Ash Enterprises
29 Riverside Drive, Apt 402
Cocoa, Florida 32922 USA
+1 941 730 3434
johnhare@earthlink.net

Immersive Audio

Charles Morrow
1961 Roaring Brook Road
Barton, Vermont 05822 USA
Phone: +1-212-989-2400
cm@cmorrow.com

International Relations

Martin George, Chair
Launceston Planetarium
Queen Victoria Museum
Wellington Street
Launceston, Tasmania 7250
Australia
+61 3 6323 3777
+61 3 6323 3776 fax
Martin.George@qvmag.tas.gov.au

Planetarium Centennial Task Force

Björn Voss
LWL-Museum für Naturkunde
Westphalian State Museum Of Natural History
Sentruper Str. 285
48161 Münster, Germany
+49-251-591-6026
+49-251-591-6098 fax
bjoern.voss@lwl.org

Planetarium Design and Operations

Ian McLennan
#404-1275 Haro Street
Vancouver, British Columbia
V6E 1G1 Canada
+1 604-681-4790 phone + fax
ian@ianmclennan.com
ian.mclennan@gmail.com
www.ianmclennan.com

Portable Planetariums

Susan Reynolds Button, Chair
Quarks to Clusters
8793 Horseshoe Lane
Chittenango, New York 13037
+1 315-687-5371
sbuttonq2c@twcny.rr.com
sbuttonq2c@gmail.com

Science & Data Visualization Task Force

Mark Subbarao
Adler Planetarium
1300 South Lake Shore Drive
Chicago, Illinois 60605 USA
+1 312-294-0348
msubbarao@adlerplanetarium.org

Vision 2020 Initiative

Jon Elvert, Chair
Baton Rouge, Louisiana
70802 USA
jelvert1@gmail.com

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

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

Planetarian (ISSN 0090-3213) is published quarterly by the International Planetarium Society. ©2020 International Planetarium Society, Inc., all rights reserved. Opinions expressed by authors are personal opinions and are not necessarily the opinions of the International Planetarium Society, its officers, or agents.

Acceptance of advertisements, announcements, or other material does not imply endorsement by the International Planetarium Society, its officers, or agents.

Note that photos may be enhanced digitally for printability only, never for content.

The editor welcomes Letters to the Editor and items for consideration for publication. The editor reserves the right to edit any manuscript to suit this publication's needs.

The online PDF version holds ISSN 2333-9063

Planetarian is part of the EBSCO research database.

Guidelines for contributors

- *Planetarian* welcomes submissions of interest to the planetarium community. Preference is given to articles that closely relate to the philosophy, management, technical aspects, educational aspects, or history of planetariums, and to ideas that can readily be incorporated into planetarium shows. Authors are responsible for obtaining all necessary copyright clearances, especially for illustrations and photographs.
- Research articles dealing with educational aspects of the planetarium and other topics are highly desirable and will be referred if applicable and requested.

- Contributors agree that their submission is their own original work and has not appeared elsewhere in print or electronically, nor is not being submitted simultaneously elsewhere in print or electronically. If the submission has appeared elsewhere in print or electronically, permission to re-print must be obtained and a copy of this permission emailed to the Editor with the article.
- Once accepted for publication, the contributor also agrees that the copyright for original works not appearing elsewhere is held by the International Planetarium Society. Once a submission has appeared in *Planetarian* (but not before the

printed version has been received by members), contributors may post the submission on a personal website, blog, or a website of general interest as long as the following appears: Copyright 2013 (or appropriate year) **International Planetarium Society; used with permission** and provide a link to the IPS. If in doubt, contact the editor with questions.

- The Guidelines for Contributors on the IPS website should be consulted before submitting an article.
- Potential advertisers are invited to check the Advertising Guidelines and Rate Sheet on the IPS website: www.ips-planetarium.org/plntrn

SkyExplorer

REAL TIME UNIVERSE

2020

INTERACTIVE EXPERIENCE



*Audience
response
system*

*"Studio": Easy
and intuitive GUI*

*Gamepad,
full Ipad control;
Manual console*

CONNECTED COMMUNITY



*Dome
Casting*

Data2Dome

*Cloud &
Social Network*

STUNNING REALISM



*Advanced terrain
and atmospheric
effects*

*Volumetric trail
and active nucleus
for comets*

*Scientific and
volumetric Milkyway &
globular clusters*



www.rsacosmos.com

RSACOSMOS



KONICA MINOLTA



Sharon Shanks
484 Canterbury Lane
Boardman, Ohio 44512 USA
+1 330-783-9341
sharon.shanks@gmail.com

The importance of live and in person

As an editor, I am uncomfortable when I have to edit stories about myself. I'm even more uncomfortable when I have to run photos that include me. My aversion to having my picture taken is legendary.

I remember that Publications Chair Dale Smith had to become stern with me when he knew I would be tempted to not run a photo, especially when I received the IPS Service Award at the 2012 Conference in Baton Rouge, Louisiana. He was right to be, because left on my own I would not have printed it.

So it was doubly difficult for me to be impartial when it came to this issue's report from the Association of Mexican Planetariums in International News (page 38). Not only was my visit to the AMPAC meeting featured, but my photo was included as well. I promise that I treated the report as I would any other, and I didn't even crop myself out of the photo.

I had a marvelous time in Mexico City at the AMPAC conference. The conference ran from November 21-22, and I gave myself a full day to just explore and learn about this huge city. I experienced some of the worst that a major city has to offer, and also some of the best.

Ignacio Castro Pinal was a gracious host and translator. My high school Spanish was no preparation for immersion into Mexico City life, but I discovered that most people spoke English. I provided opportunities for them to practice.¹

After the conference I moved from the conference hotel to a sister establishment on the Paseo de la Reforma near the museum district downtown, and discovered I had a literal front-row seat for the Navidad parade. The grandstand was directly across from the hotel.

I'm not sure if I can describe being part of an event that covered so many square miles and held so many people, except that it was overwhelming. There had to be a million people in the streets, and I can say this often hyperbolized statement honestly. The city itself has 8.8 million residents.

The most important lesson from this visit: that being there, meeting people face to face, being open and honest is so very important to overcoming ignorance. It was a learning experience I will always remember.

Putting up with name dropping

Others have mentioned me in their columns from time to time, and I usually leave them in, or sometimes reply in the spirit in which the reference is made in a footnote. Most notorious for this is Ron Walker in his column A Different Point of View. Tim Barry also has been known to mention me in his Outside Space Column.

In this issue, Mark Percy also mentions me while introducing himself as the new associate editor of *From the Classdome* (page 34).

Mark is coordinating a cadre of classdome teachers who will take turns writing for *Classdome*, sharing their best practices and teaching techniques in planetariums located in public schools. This is a population within the planetarium community that really needs more recognition and requires more respect than we have given them in the past.

¹One of the best English speakers was a roaming shoe shiner, who outrageously overcharged me for cleaning my admittedly dirty shoes. Actually, months later, they still look pretty good.

Not only do classdome planetarians have to have all the skills that, but they also have to write and file lesson plans, issue grades, deal with parents and school administrators, and juggle all this with a home life and extra duties at school. They are the true representatives of doing a job for the love of the planetarium.

Planetarians continue learning in Chile

In this issue is a third article recounting the experience of taking part in the Astronomy in Chile Educator Ambassador Program (ACEAP). This is a great show of support from our field for such an educational and life-changing opportunity.

This time, the article is from Amy Barraclough at Edelman Planetarium, Rowan University, Glassboro, New Jersey and Carla Johns, Fiske Planetarium, University of Colorado Boulder.

In 2018, authors Tiffany Wolbrecht and Stephen Case shared their experience (see Vol 47, No 2, September 2018, "Southern Skies: Astronomy in the Upside Down"). Tiffany is my successor at Youngstown State University, and Steve is at Strickler Planetarium at Olivet Nazarene University in Bourbonnais, Illinois.

In 2015, the authors were Pete Dettlerline from Boyertown Planetarium, Pennsylvania; Renae Kerrigan, Peoria Riverfront Museum, Illinois; Sarah Komperud, Bell Museum of Natural History, Minnesota; Jim O'Leary, Maryland Science Center; Mike Prokosch, Sam Houston State University, Texas; and Shannon Schmoll, Abrams Planetarium, Michigan. ("Astronomy from the Top of the World," Vol 44, No 3, September 2015).

Here is a list of excited, invested planetarians who are in the process of changing the face of our profession and who will soon be the leaders of IPS. Ask any one of them about the value of face-to-face experience and travel; I'm sure they will be happy to share.

Week in the U.S. continues to succeed

Another report about meeting and making friends from afar comes from John Meader, who tells of the enjoyable "Week in the U.S." experience with Ruth Grützbauch from Austria. What he discovered is exactly what this professional development experience from IPS intended: that "the true value of this exchange was sharing our differing styles and equipment." (Read more on page 16.)

Wrapping it together

There is a strand that runs through everything I have written here: that travel and meeting people face to face is important. We do this through our regional conferences, and once every two years we gather at IPS conferences (coming up, of course, this June in Edmonton).

My challenge to you, the reader: let's do more of this. ☆

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

Meet the New Star Projector of the Digital Age
Simple, Compact, Powerful

MEGASTAR-Neo



MEGASTAR-III

MEGASTAR-IIA

* The above image of Megastar-Neo shows its relative size compared to MEGASTAR-IIA (right in the background), MEGASTAR-III (left in the background) and the soccer ball.

- Requires minimum space, best for integration with digital planetariums.
- One million stars, 16 individual bright stars, over 170 deep space objects.
- 12 LED units, MEGASTAR deep and realistic sky quality.
- Affordable for small to mid-range planetarium domes 5m-15m.
- Lightweight, can be carried by one person.



Ohira Tech Ltd.

Ohira Tech

Tel: +81-(0)45-507-3531
Contact: sales@megastar.jp

<https://www.megastar.jp/>



Mark SubbaRao
Adler Planetarium
1300 South Lake Shore Drive
Chicago, Illinois 60605 USA
+1 312-294-0348
msubbarao@adlerplanetarium.org

Getting excited about Edmonton

IPS 2020 Edmonton is coming—I hope you've already made your preparations. If not, then please do so soon. For those of you who may be deciding if you should attend this year, this column will serve as a pitch for why you should join us.

But, in reality, the main reason for attending isn't any of the things I will describe below. It is because this is the time to gather with the global planetarium community, to greet old friends and to make new ones. This isn't just the place to see the state of the art in our field; it is the place to start the collaborations that will advance the field in the future.

IPS 2020 will be more than just a conference this year, it will be a megaconference. On June 18-19 we will hold the IPS Fulldome Showcase. The showcase is your opportunity to see the best work from fulldome producers all around the world. In addition to full-length productions, there will be artistic and experimental works that are expanding the boundaries of the medium.

On June 20, it will be IMERSA Day at IPS 2020, a "mini" IMERSA Summit. IMERSA is an affiliate organization of IPS, through which members of the domed and immersive communities share their work, successes, and insights. Through a mix of keynote speakers, panel discussions, and dome presentations, IMERSA will showcase its strong commitment to digital immersive art and science.

On June 21, another IPS affiliate organization, LIPS, will also hold a special "mini symposium." The full-day session will specifically focus on live, interactive planetarium lessons, like connecting with your audience, enhancing performance skills, learning classroom management techniques, taking part in sample activities, and many more useful skills in preparing and performing live presentations under the dome.

The welcome reception kicks things off

After these optional pre-sessions, the main IPS conference begins with a welcome reception on the evening of June 21. Over the next four days there will be over 70 different program sessions. These sessions cover an incredible variety of topics. Some examples include "Aesthetics of the Planetarium Experience," "Planetaria in Africa," "Projects for

the 100th Anniversary of the Planetarium," "LED Domes," "Indigenous Astronomy in the Planetarium," and many, many others.

The exhibit hall should be especially interesting this year. There have been several exciting technological innovations in the planetarium world in the past couple of years; this is your chance to see the state of the art.

We have some fantastic keynote speakers lined up. Wilfred Buck, Manitoba First Nations Education Resource Centre, will present the opening session. He is a leader in an effort to preserve and rediscover indigenous sky knowledge that is being lost. He travels throughout Canada, using a portable planetarium re-introduce that knowledge to indigenous communities. There will also be special events, including the ribbon-cutting ceremony for the newly-renovated Queen Elizabeth Planetarium. This planetarium, which opened in 1960, was the first planetarium in Canada. There will be amazing mid- and post-conference tours, many of which will let you get out and experience amazing Canadian landscapes and wildlife (who wants to go river rafting with me?).

You ask "how will we be able to pack in so many activities in just one week?" Well, we have the advantage of really long days. Edmonton is at 53.5 degrees north latitude, and we'll be there over the summer solstice. The sun won't set till after 10 p.m. ☆



Top: The dome is coming together on the Queen Elizabeth Planetarium, with the Telus World of Science-Edmonton in the background. At the IPS conference we will hold the ribbon-cutting reopening ceremony for the first planetarium in Canada. Below: This year's IPS conference will have some amazing mid- and post-conference tour opportunities. After the conference, I'll be joining the tour to Jasper, the largest national park in the Canadian Rockies and part of UNESCO's Canadian Rocky Mountain Parks World Heritage Site. Images courtesy Telus World of Science-Edmonton.

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

DINOSAURS @ DUSK

the origins of flight



Also available in 3D



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

mirage 3D

For licensing please contact Robin Sig: rsig@mirage3d.nl

Letters to the Editor

The lights are on at the Schreder Planetarium

To: Mark SubbaRao, President
International Planetarium Society, Inc.

Dear Mark,

In the June 2016 issue of *Planetarian* magazine an article I wrote appeared that described a challenge we faced in maintaining and improving the Schreder Planetarium in Redding, California. We were faced with fiscal shortfalls, aging equipment and wavering leadership from the Shasta County Office of Education (SCOE) which owns the planetarium.

We began an outreach to involve the public in our efforts to improve the understanding of our goals and provide a pathway to

Programs Nathan Fairchild designed pre- and post-lessons for teachers to provide meaningful instruction to students who attend planetarium shows. The curriculum is linked with classroom activities to foster thinking and problem-solving. These exciting new lessons tie directly to current Next Generation Science Standards. Nathan has also developed hands-on exhibitry at the planetarium, including an Augmented Reality Sandbox.

Together, SCOE and the Friends have championed increased community interest in the planetarium. Due to improved social media outreach, public attendance at the planetarium has increased substantially. In August 2016, only 30-40 tickets out of a total capacity of 64 seats were sold per show one Friday night per month. Since August 2016 the number of public shows has doubled and 94% of planetarium public shows have sold out. Guests range in age from a 4-year old attendee, who can name planets and dwarf planets by sight, to adults returning to the planetarium with children and grandchildren, fondly repeating the experience they enjoyed as students.

The Friends raised \$133,190 from grants and local donors which was matched by the Shasta County Board of Education with \$133,190 to purchase a Spitz IQ 2400 state-of-the-art projector and sound system. After 40 years of continuous operation, we are on the road to a bright future.

In 2016 I stated "I don't know what influenced Elon Musk or two boys in a garage in Palo Alto 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."

The lights are on at the Schreder Planetarium in Redding. ☆

Jack Schreder
Redding, California



the survival of our treasured asset. We founded Friends of Schreder Planetarium (Friends), a non-profit 501c3 organization to raise funds and provide volunteers for Friday evening public shows. As the only astronomy education center in the north state, the Schreder Planetarium has entertained and educated thousands of students in Shasta County and schools throughout the north state. Director of Science

Nominations now being taken for officer positions

Martin George
Chair, IPS Elections Committee

Nominations are open for the positions of IPS president elect, secretary, and treasurer for the 2021-22 terms. I, Martin George, as Chair of the Elections Committee, am keen to receive nominations. These can be sent to me at martingeorge3@hotmail.com.

Nominations will also be received from the floor at the 2020 IPS Conference in Edmonton, Canada, after which the period for nominations will close.

It is important to note that this election is quite separate from the election of IPS Board Members, which took place near the end of 2019. The Board Members and Officers (including the President and Past President) will meet in Edmonton before the 2020 IPS Conference.

The IPS election process is your chance, as an IPS member, to have your say in who you would like to see filling these important positions and how the IPS is run.

Note that the terms of office for secretary and treasurer are two years each, and that the term of office of president elect will be followed by two years as president in 2023-24 and two years as past president in 2025-26.

The secretary and treasurer may hold office for up to three consecutive two-year terms. The current treasurer, Ann Bragg, will have complete six years at the end of 2020 and thus will be term limited out. The current secretary, Patty Seaton, will have served for one term, and thus is eligible for re-election if she chooses to stand for the seat.

If you are interested in standing for one of these positions, you are welcome to contact me (Martin George) at the email address mentioned above to discuss the duties of IPS Officers. You would, of course, need to be nominated if you choose to stand, but I shall be very happy to help you with any information. ☆

A new fulldome experience from the CALIFORNIA ACADEMY OF SCIENCES

EXPEDITION Reef

Embark on a journey into the hidden world
of coral reefs in the new fulldome experience
from the California Academy of Sciences.

Available for licensing



CALIFORNIA
ACADEMY OF
SCIENCES

For more information on licensing our shows, visit www.calacademy.org/licensing.



Chile: ACEAP ambassadors bring the big science back to the public

Amy Barraclough
Edelman Planetarium, Rowan University
Glassboro, New Jersey
barraclough@rowan.edu

Carla Johns
Fiske Planetarium, University of Colorado Boulder
carla.johns@colorado.edu



Being alive during the golden age of big science and the systematic unraveling of the universe makes those of us in the planetarium world count our lucky stars. Sharing new discoveries to age old questions is especially rewarding when educators have had firsthand experience and have visited the research facilities where the heavy lifting is being done.

The Astronomy in Chile Educator Ambassador Program (ACEAP) brings together astronomy educators from across the country to visit U.S.-funded observatories in Chile.

The program, funded by the National Science Foundation (NSF), is a collaboration between the Association of Universities for Research in Astronomy (AURA), the National Radio Astronomy Observatories (NRAO), National Optical Astronomy Observatories (NOAO), and Gemini Observatories. ACEAP builds a corps of ambassadors to receive training in the science and data coming out of these observatories in order to communicate these research findings and concepts to the public.

Every year, approximately ten ambassadors are selected for the 10-day expedition. All ACEAP ambassadors have a background in astronomy education as K-16 teachers,

amateur astronomers, planetarium professionals, or informal educators.

The 2019 cohort included a good mix of astronomy professions: two teach astronomy at the college level, two teach at the middle and high school level, two are retired engineers actively involved in astronomy outreach, one is a journalist working for the U.S. Antarctica Program, and two work at planetariums separated by nearly 1,800 miles. Everyone in the cohort quickly bonded over a shared love of astronomy, dark skies, and enthusiasm to bring space science to our audiences.

Chile has quickly become the unofficial astronomy capital of the world. Dr. Luis Chavarria, director of the Astronomy Program within Chile's National Commission for Scientific and Technological Research (CONICYT), shared with our cohort that seventy percent of all the optical and infrared telescopic collecting power will be located in Chile by 2022.¹

¹ "Development Funds of the National Astronomy: Astronomy Program," CONICYT National Commission for Scientific and Technological Research, accessed January 14, 2020, www.conicyt.cl/astronomia/astronomy-program/.

Chile: global astronomy hot spot

The commitment towards establishing the infrastructure to support large research facilities, combined with the recent presidential decree to implement measures for limiting light pollution across the entire country, has clearly put Chile on track to remain a global hot spot of astronomy for years to come.

Not only has Chile's proximity to the equator made it an attractive place to build observatories, but its geography in the northern regions of the country is ideally suited for large scale projects.

The extreme elevations of this region create the highest, driest desert plateau in the world, the Atacama. Sandwiched between the Chilean Coastal Range to the west and the Andes to the east, the Atacama desert is an extremely arid region under a nearly constant temperature inversion. Additionally, the average precipitation in the region is less than half an inch per year, making it ideal for observing the far reaches of the universe.

The highly acclaimed ALMA, Atacama Large Millimeter/sub-millimeter Array, spans 16 kilometers on the Chajnantor Plateau at an elevation of 16,500 feet above sea level, above

Facing page: The Atacama Large Millimeter/submillimeter Array (ALMA) at 16,500 feet above sea level with penitentes in the foreground and to the right, the Atacama Compact Array. Photo by C. Johns (ACEAP/NSF). In circle, the 2019 ambassador cohort stands in front of the Blanco 4-meter telescope at night on Cerro Tololo Inter-American Observatory. Photo by L. Sparks (ACEAP/NSF). Penitentes are are snow formations found at high altitudes. They take the form of elongated, thin blades of hardened snow or ice, are closely spaced, and point towards the general direction of the sun.



Left: A radio dish at the Very Large Array stands still while Earth rotates around it. Right: The Milky Way rises from an observatory at Cerro Tololo Inter-American Observatory. Photos by A. Barraclough (ACEAP/NSF)

nearly half of Earth's breathable atmosphere.

The plateau is surrounded by towering peaks and volcanoes that rise to even greater heights.

Conditions here are extreme and the UV radiation index, which is usually described on a scale from 0 to 10, hits 25 regularly and has been recorded as high as 43. That, combined with the high altitude of the sun and low ozone levels, make it almost an unworldly place to conduct research.

The ALMA Array consists of 66 antennas: 54 are 12-meter dishes and 12 are 7-meter dishes.² Despite there being four different designs of antennas built by different countries, the dishes were built with such precision that the parabolic surfaces remain uniform to better than 12 microns across the entire surface of each antenna. Each 100-ton antenna's receiver is chilled to a few degrees above absolute zero to suppress unwanted noise.

Forming the EVT

In addition to discovering the most distant dusty galaxy (MAMBO-9) seen just 970 million years after the Big Bang, moons forming in circumplanetary disks (PDS 70), and the most massive neutron star ever detected (J0740+6620), ALMA was one of eight radio telescopes spread over four continents forming the Event Horizon Telescope (EHT) which directly imaged the supermassive black hole centered in M87. ALMA was crucial to making this discovery possible as the most

sensitive and largest array of the EHT which collectively achieved resolution of 20 micro-arcseconds.

NRAO stated this resolution was equivalent to seeing, "the size of the period at the end of this sentence if you were looking from the moon... This is just the latest step in a journey that began nearly 50 years ago with the National Radio Astronomy Observatory's (NRAO) Green Bank Interferometer: the first telescope to identify and locate the supermassive black hole at the center of the Milky Way."³

The Gemini South Observatory, located 600 miles to the south of ALMA, continues to make ground-breaking discoveries as it enters another decade of service. Gemini South is an 8-meter telescope located on Cerro Pachón in the Coquimbo region of Chile. Cerro, a word meaning hill in Spanish, is an ironic name for this peak, which stands nearly 9,000 ft above sea level.

The observatory is the southern hemisphere twin of the Gemini North telescope on Mauna Kea in Hawaii. Together, the twin 8-meter telescopes can access the entire night sky and have provided some interesting insights into our own solar system and beyond.

In 2015, using the Gemini Planet Imager (GPI), a dedicated planet-finding instrument on Gemini South, astronomers announced

the discovery of exoplanet 51 Eridani b, the most Jupiter-like planet discovered around another star.

GPI differs from other exoplanet detectors which use indirect methods of detection to find planets. Instead, GPI can directly detect planets by taking a picture of them next to their parent stars. 51 Eridani b, a planet about twice as massive as Jupiter, orbits 2.5 times farther away from its star than Jupiter orbits the sun. Its detection was part of a 4-year exoplanet survey that completed observations in January 2019.

Since 51 Eridani b's discovery, very few Jupiter-like planets have been discovered, suggesting that gas planets far from their star are rare, a result which is expected to be confirmed as review of the survey is completed in the coming months.⁴ At the conclusion of the survey follow-up, GPI will undergo upgrades to make it more sensitive to smaller mass planets that orbit closer to their host star and will move to the Northern Hemisphere to begin a new planet survey at Gemini North.

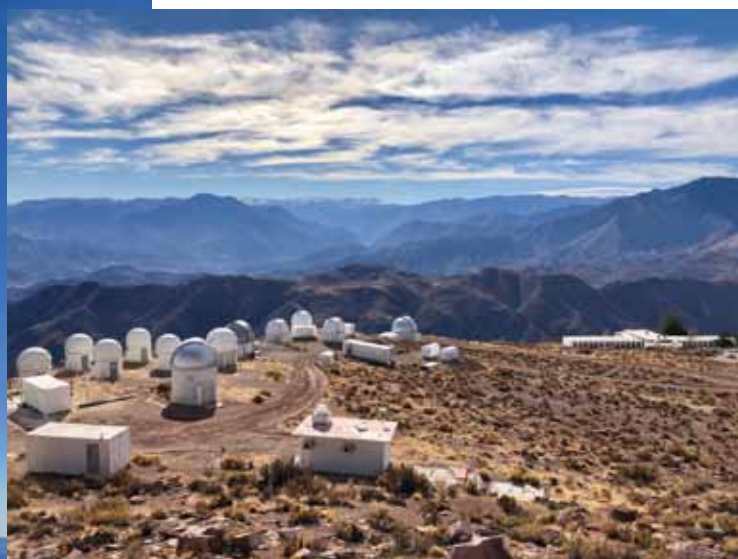
Gemini South also discovered hydrogen sulfide in the clouds of Jupiter; observed an occultation of a star by Vanth, a tiny moon of a trans-Neptunian object which led to the unexpected discovery that the star was a binary; and observed Oumuamua during its solar system flyby in 2017.

(Continues on next page)

² "Atacama Large Millimeter/submillimeter Array: ALMA Basics," National Radio Astronomy Observatory, accessed January 14, 2020, public.nrao.edu/telescopes/alma/.

³ "How a Telescope Made Mostly of Nothing Became Astronomy's 'Killer App,'" National Radio Astronomy Observatory, April 10, 2019, public.nrao.edu/news/2019-eh-t-news-room/.

⁴ "Gemini Planet Imager Planet Search Shows Giant Planets Orbiting Sun-like Stars May Be Rare," Gemini Planet Imager Exoplanet Survey, June 12, 2019, planetimager.org/.



Left: The Vera Rubin Observatory (Large Synoptic Survey Telescope) takes shape in the center distance on Cerro Pachón as the Gemini South Observatory looks on. Above: The mushroom farm, dormitory, and casino cafeteria at Cerro Tololo Inter-American Observatory. Photo by C. Johns (ACEAP/NSF)

Coming soon: The LSST

Also located on Cerro Pachón is the much-anticipated NSF-funded Large Synoptic Survey Telescope (LSST), now officially renamed the Vera C. Rubin Observatory.⁵ This modern-day marvel will produce the deepest, widest images of our universe with an 8.4-meter mirror and a 3,200-megapixel camera. It is anticipated the observatory will collect 15-30 terabytes of data nightly. Not only are we sure to learn more about dark energy and dark matter, but the powerhouse imaging capability will reveal answers to questions we can't even fathom right now.

Meeting the Victor Blanco

Six miles as the crow flies—though much farther when driving the winding dirt roads through the mountains—is Cerro Tololo, home to the Cerro Tololo Inter-American Observatory (CTIO). CTIO houses dozens of telescopes ranging in size from 0.5m to 4m. Some smaller robotic telescopes on the lower plateau have been nicknamed “the mushroom farm” because they appear to just pop up from the ground.

The largest telescope on CTIO is the venerable 4m Victor Blanco telescope, which was used to confirm that the expansion of the universe was indeed accelerating. This discovery was named the 1998 “Breakthrough of

the Year” by *Science Magazine*⁶ and earned the researchers a Nobel Prize in 2011.

Today, astronomers are building on that discovery with the Dark Energy Camera (DECam) installed on the Blanco telescope.⁷ DECam comprises 62 CCDs with 520 megapixel resolution.⁸ It is surveying distant galaxies to discover the nature of dark energy as part of the Dark Energy Survey Project led by Fermilab in Illinois.

While a trip to Chile to visit some of the world's best observatories may seem like an astronomer's dream vacation, the ACEAP experience is far from restful. During the 10-day expedition, ambassadors covered over 2,000 miles in 3 domestic flights, took multiple hours-long bus rides, and kept an intense schedule filled with site tours, science and outreach lectures, and talks with observatory executives.

And the work doesn't start or end with the expedition. In the months leading up to the journey, ambassadors met virtually for trainings on how to use social media more effectively, how to photograph the night sky,

and what to expect during the trip. After we returned, we attended follow-up virtual meetings, an annual program meeting at the Very Large Array in Socorro, New Mexico, plus we began completing our many outreach activities.

Currently, the ACEAP program has 50 active ambassadors who enthusiastically share all that they learned from their coun-

(Continues on page 22)



Carla looks out the window on a flight to Calama. Photo by A. Barraclough (ACEAP/NSF)

⁵ “First national US observatory to be named after a woman!” LSST News, January 6, 2020, www.lsst.org/news/vro-press-release.

⁶ Alan Boyle, “Science lists 1998's biggest breakthroughs,” NBC News, December 17, 1998, www.nbcnews.com/id/3077857/ns/technology_and_science-space/t/science-lists-s-biggest-breakthroughs/#.Xh3rqMhKhaQ

⁷ “The DES Project: Overview,” The Dark Energy Survey, accessed January 9, 2020, www.darkenergysurvey.org/the-des-project/overview/.

⁸ “Dark Energy Camera (DECam),” Cerro Tololo Inter-American Observatory, accessed January 9, 2020, www.ctio.noao.edu/noao/content/dark-energy-camera-decam.

NARRATED BY RICHARD DORMER

BIRTH OF PLANET EARTH

SPITZ
CREATIVEMEDIA

TLP

I ILLINOIS NCSA



TELLUS
SCIENCE MUSEUM



**FULLDOME
SHOW**

www.spitzinc.com/fulldome_shows

DISTRIBUTION

Contact: Mike Bruno

mbruno@spitzinc.com

T: 610.459.5200



A perfect match: Kindred spirits share the stars, education through professional development exchange

John Meader
Northern Stars Planetarium
Fairfield, Maine USA
jtmeader@gmail.com
john@northern-stars.com

In September 2019 I served as a host to an international colleague as part of the IPS “Week in the United States” program. My visitor was Ruth Grützbauch from Vienna, Austria. It’s an outstanding program, and I urge my colleagues to consider participating.

When I was asked to host a colleague in this program, I had to discuss it with my wife, Laura. Since I’m self-employed, I knew that to be a host would mean not only hosting this person in the dome, but also in our home. We discussed it and fairly quickly decided it could be a fun and fascinating week.

The first step was to help choose the recipient. There were several well-qualified candidates. I wanted the exchange to be mutually beneficial. Since I have operated a portable planetarium small business since 1987, I wanted to host a fellow portable-user. After

reviewing the applicants, it was clear that the best fit was Dr. Ruth Grützbauch from Austria. Ruth has her PhD in astronomy, and started her own portable planetarium business in her native Vienna. Being new to this type of endeavor, I felt like my years of expertise might provide her with some valuable insights, while her more modern approach to teaching in a portable with digital equipment would also expand my sensibilities, which are decidedly old-school. I think that both of these premises turned out to be true in the end.

The next step was to put a schedule of events together for her visit to Maine. September is the best time to fit the visit into my work schedule. In Maine there are two major star parties in September, each a week apart around the date of the new moon. They seemed like the perfect bookends to an astronomical week in Maine, so we set the dates.

Ruth and her partner, Georg Zenta, arrived on September 19. They had flown in a week early to explore New England and Maine a bit on their own. I was pleasantly surprised that they leaned heavily on outdoor experiences, like camping in New Hampshire’s White Mountains and climbing 4,800-foot Mt. Moosilauke. Entering Maine, they traveled to the North Maine Woods to explore Moosehead Lake before circling to the Downeast

coast to visit Cobscook Bay. These are all far-flung regions of northern New England. Being an avid outdoor enthusiast myself, I knew that we were going to get along just fine.

On Friday, our first day together, we went to the Common Ground Country Fair in Unity, Maine, for a taste of rural Maine life. Common Ground Fair is a true rural fair. There is no midway and no rides, but lots of good food, fine crafts, people, and educators of all persuasions. It was a relaxed way to get to know each other better outside of the world of astronomy education.

Off to Katahdin Woods

On Saturday we made the three-hour drive north to Katahdin Woods and Waters National Monument for the Stars Over Katahdin star party. The event takes place 15 miles down a dirt road, deep into the heart of the national monument. We would be part of the Astro VIPs that the park sponsors each year to lead the star party.

Ruth and I both presented short “fireside chats” before dark. I told a sky legend while Ruth discussed galaxies to the small crowd. As darkness fell we moved to the telescopes to share the night sky with the public throughout the evening. I brought along my Celestron 8” Schmidt-Cassegrain along with two 4” Astroscan reflectors. I focused on keeping

Reprinted with permission from the Winter 2019 edition of *Constellation*, the newsletter of the Middle Atlantic Planetarium Society.

Facing page: John Meader, ready to present a pair of presentations in his Northern Stars Planetarium's 6.7m dome set up at the Jesup Memorial Library in Bar Harbor, Maine for the Acadia Night Sky Festival. Inset: John Meader, Ruth Grützbauch, and Georg Zenta at the summit of The Beehive, Acadia National Park. All photos by the author.

the C-8 on interesting objects while helping people understand what they were seeing. Ruth, who had never seen an Astroscan, took on the two little red telescopes with pleasure, helping people learn how to operate them in a hands-on fashion. We had a great evening, enjoying the incredible dark skies of Katahdin Woods and Waters—one of the darkest sites east of the Mississippi River.

On Sunday morning we headed home with a stop by the Emera Astronomy Center at the University of Maine in Orono, where we were greeted by Shawn Laatsch, the center's director. After a quick tour we joined the public for a planetarium show at the Emera Center's Jordan Planetarium.

First day teaching

Monday was Ruth's first day teaching in my dome. We visited Manchester Elementary School in Manchester, Maine, where Ruth presented two shows: one for 60 second- and third-grade students, and one for 60 fourth- and fifth-grade students.

In Austria, Ruth has a 5-meter inflatable dome with a cleverly built homemade video projector using her laptop, an LCD video projector, a 2" right angle prism, and an 8mm wide angle camera lens.

Clearly, she didn't bring her dome along with her on the plane, but she did bring her laptop and video projection system. Worried a bit at first that her projector might not be bright enough inside my larger (6.7m) dome, those fears were soon allayed, as the image looked great. The students at Manchester delighted in her presentation. They loved Ruth and her "funny accent" and had questions about where she was from, what language she spoke, and why she was here. It was a great chance to expose these kids to someone else's approach to teaching astronomy as well as the chance to meet someone from another part of the world.

On Tuesday we returned to the Emera Astronomy Center at the University of Maine. This time it was Ruth's turn to do a presentation in the Jordan Planetarium. Director Shawn Laatsch helped Ruth prepare; the planning was important because she would present the show in German for university language students and a German community group. Shawn would operate the console



Above: Ruth's fireside chat at the Stars Over Katahdin star party at the Katahdin Woods and Waters National Monument, and left: the star party itself. Note the visibility of the Milky Way.

and Ruth would do the talking. The group of German speakers arrived for a wonderful astronomy presentation in Ruth's native tongue. Shawn and Ruth worked off each other's cues and all went as planned.

Public shows sell out

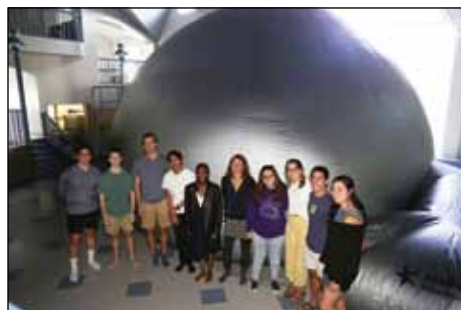
To offer a set of public shows for the local area I contacted a local arts and culture organization called Waterville Creates who agreed to sponsor the event. On Wednesday at 4 pm Ruth presented a family/after school program for children of all ages. We had about 45 kids, along with a smattering of moms, dads, and grandparents. At 5:30 a second public show was given, but this one was an "adults only" presentation. Both shows sold out.

Thursday had the busiest schedule of the week; luckily the day didn't involve any travelling. All the presentations were at Waterville's Colby College. The day started and ended with a German language presentation. The first show was for first-year German students whose language skills were still rudimentary, so Ruth worked back and forth between German and English. She did a fantastic job giving the students just enough English to help them understand the astronomy presented in German.

The show was followed by a luncheon hosted by the college's "Women in Physics" group. Ruth was the guest of honor and she presented a short talk about her experiences as both a graduate student and as a professional astronomer.

After lunch we had two more planetarium

(Continues on next page)



Top: Ruth presenting to the Colby College (Waterville, Maine) Space Club in my 6.7m dome using her all-sky projector set on top of my portable console. Center: Ruth with Colby College German language students before her presentation. Bottom: Colby College astronomy professor Elizabeth McGrath gives Ruth and me a tour of the Young Observatory located on the Waterville campus.

shows on the docket. First was a presentation for the Space Club (in English), followed by a second presentation in German for the more advanced language students. At the end of the day, astronomy professor Elizabeth McGrath took us on a tour of Colby's Young Observatory, which holds a 7.1m reflecting telescope—the largest in Maine. Unfortunately, we didn't get to observe as clouds and rain moved in.

The second star festival

On Friday the skies cleared and we travelled to Acadia National Park to participate in the annual Acadia Night Sky Festival. Along the way we stopped at the Penobscot Narrows Bridge Observatory. It's not an astronomical observatory, but an observation deck at the top of one of the towers of the cable stay bridge. The "observatory" is 420 ft (128m) above the water, the highest bridge observation deck in the world.

Eventually, we ended up at the Seal Cove Auto Museum, host of the evening's star party. The skies were clear and there were about fifty telescopes set up in the field beside the museum. Again we set up the C-8 and spent the evening sharing the wonders of the night sky with hundreds of guests.

On Saturday, the clouds came in and cancelled the observations for the day, but we had a great time exploring Acadia. We hiked up the small but steep and exposed cliffs of The Beehive, wandered the shores of Sand Beach, and poked around the small shops of Bar Harbor before a delightful dinner together at a local Thai restaurant.

Sunday morning gave Ruth a chance to see me in action. I had two shows scheduled at the library in Bar Harbor as part of the Night Sky Festival. I gave an astronomy show called *Earth, Our Home in the Cosmos* and a second called *Skylore From Around the World*. After a week of shop talk together, Ruth and Georg both seemed eager to see how I do my presentations in the dome. After all, this week is all about an exchange of ideas and that is a two-way street!

Our culminating event of the Acadia Night Sky Festival was to attend a lecture on Sunday afternoon by Dr. Margaret Geller, an astrophysicist from the Harvard-Smithsonian Center for Astrophysics. Dr. Geller is an expert on galaxies, and galaxies were also the focus of Ruth's Ph.D. thesis, so it was a great way to top of a week of astronomy in Maine.

The true value: sharing

From my perspective, the week was a great success. While Ruth and I both share a love of astronomy and teaching in our respective portable planetariums, the true value of this exchange was sharing our differing styles and equipment.



Top: Ruth Grützbauch and her partner Georg Zenta posing with Mount Katahdin, Maine's highest peak, in the background. Center: Ruth taking questions from kids before her family presentation in Waterville, Maine. Bottom: Ruth hamming it up while climbing the very exposed trail up the Beehive at Acadia National Park.

I have two STARLAB domes, a 4.9m and a 6.7m. I use a fiber-arc analog STARLAB projector and have a variety of cylinders that I can use. I have a portable console that controls more than a dozen special effects, two Ektagraphic slide projectors, a video projector and laptop. I use a Bose Acoustic Wave sound system, and I bring a stool and a carpet. My set-up fills a Honda Odyssey mini-van and takes an hour to set up. I am gear heavy.

Ruth, on the other hand, has a single dome and a laptop with an all-sky projector. She carries everything she needs in her cargo bike. She can actually ride a bicycle to work with her dome and projector! I envy her light load. As you can imagine, just on the hardware end

of things, we had a lot to discuss and share.

Our presentation styles vary from each other largely due to these differences in our equipment and what it allows us to do. Ruth's equipment allows her presentations to be more free form than I can do with mine. Using Starry Night software, she can easily jump from one thing to another, say Venus to Saturn, if that's what the audience is interested in or that's where she wants to go. The software allows her to be less linear. I admire that flexibility. I tend to have a more planned itinerary. Using slides and PowerPoint tends to make presentations more linear. Yes, you can skip slides and sneak around a bit in PowerPoint, but it's tricky, you have to keep careful track of where you are, while you're busy interacting with the audience at the same time.

The value of storytelling

Another point of discussion was the value of storytelling. Ruth had never included lore into her presentations. As she said, she is an astronomer, and she has always focused on the science of the sky. But she was intrigued by my use of sky lore within my shows. I like to unite the humanities with the sky and have always valued interdisciplinary connections.

When we parted, I gave Ruth a couple of books on sky lore. She seemed intrigued by the idea of exploring the lore of the sky a bit in her presentations. I, on the other hand, am looking into her affordable all-sky projector to add to my mix, allowing me to simplify my outfit and offer programs that are more open in style. As I age, I find I long to make things simpler. Ruth has shown me an practical way to move in that direction.

I think we both parted with a lot to think about. There was so much to share and learn from each other, it's hard to quantify, but in the end, most importantly, we became true and fast new friends.

With thanks to IPS and MAPS

For all this I must give thanks to the International Planetarium Society for sponsoring this exchange. It was invaluable. I urge my colleagues to consider either traveling abroad or hosting an international colleague. It will expand your understanding and perspective in both style and methods. Also, thanks must go to the Middle Atlantic Planetarium Society and its board members who helped make this hosting possible. The financial assistance was vital.

Finally, a big thanks to Susan Button who continually encourages me to step up, get out of my comfort zone, and take part in the larger planetarium community. Susan, you are among the best in our field and I'm proud to call you my friend and colleague. ☆

NARRATED BY LIAM NEESON

DYNAMIC EARTH

Exploring Earth's Climate Engine



Public Choice Award
Short Films
Espinho Immersive Film Festival 2011



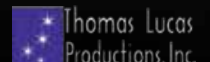
Golden Star Award
South Korea
Planetarium Fest 2012



Award Winner
Marine Biosphere
Jena Fulldome Festival 2011



Finalist
Jackson Hole
Science Media Awards 2012



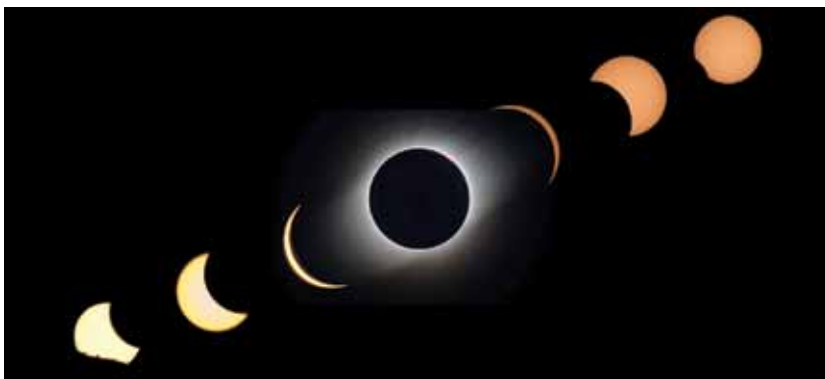
FULLDOME
SHOW DISTRIBUTION

www.spitzinc.com/fulldome_shows

Contact: Mike Bruno

mbruno@spitzinc.com

T: 610.459.5200



Bob and Mark's excellent eclipse adventure

Well, mostly excellent. There was snow. And no heaters. And then no buses.



Mark Percy
Williamsville Space Lab Planetarium
1595 Hopkins Road
Williamsville, New York 14221 USA
mpercy@willamsvillek12.org

For the 2017 total solar eclipse, the Milwaukee (Wisconsin) Public Museum led a group trip to the path of totality in Texas. Shortly after that, the MPM decided to mount an even more ambitious expedition to view the total eclipse of July 2, 2019.

That path of totality would cross the southern Pacific Ocean and then the South American countries of Chile and Argentina. MPM Planetarium Director Bob Bonadurer led an intrepid group of 40 people in hopes of experiencing totality for another two and a half minutes.

I am the director of a school planetarium in the suburbs of Buffalo, New York, and I am also a frequent customer of the MPM's planetarium show distribution department. While discussing licensing another show with Bob during the spring of 2018, he suggested that I join the expedition. It took a little convincing, but my wife and I decided to join the adventure. My wife's fluent Spanish speaking skill helped seal the deal.

Bob asked me if I could bring some telescopes and eclipse viewing gear. I had experienced totality from Kentucky in 2017, so I knew that my Astroscan fitted with a sun funnel would be great to have along. I also wanted to bring the Coronado PST, a Sunspotter, and my binoculars with solar filters. I figured on shipping the gear ahead of time,

so I took everything to the UPS store to get a cost estimate. The shipping, insurance and duty was estimated to cost \$3,000-\$4,000 USD! As that seemed to be a very steep price, I investigated a plan B: taking them as checked luggage. As long as I could keep the case under 70 pounds, it would only cost \$100 each way. I carefully packed and repacked a Pelican road case until it all weighed in at 69.5 pounds.

Since we live in Buffalo, my wife Amy and I drove to Toronto and flew from there to Miami to meet the rest of the group on our way to Santiago, Chile. The overnight flight was about 8 hours and the massive Andes range was visible through the window in the early morning light. Immigration in Santiago was mobbed as huge numbers of eclipse chasers descended on the region.

Getting acclimated

Bob and the tour company planned a three-day stay in Santiago for us to acclimate and experience the culture of Chile. Bob surprised the group with eclipse "merchandise" that he had brought: t-shirts, winter hats, and more. While there was no jet lag because Chile is on approximately the same longitude as Buffalo, we did experience "season lag." We had left the summer heat at home to arrive at the start of Chile's winter. Those winter hats would soon come in very handy.

On the second day's agenda was a bus trip into the mountains. A long and winding venture up the mountain started off with a stop to put on tire chains in a serious snow storm. While we weren't able to reach our

intended destination of Farallones, we did visit some winter recreational areas and had a fantastic lunch at a ski resort. Realizing that I had not brought enough warm clothing, that evening my wife and I found Santiago's big mall and purchased another sweatshirt.

No matter where you are in Chile, you are sandwiched between the Andes and the Pacific Ocean. On the third day, we travelled in the opposite direction and visited the home of Chile's beloved poet, senator, and ambassador, Pablo Neruda. On the way, our tour guide Rodrigo explained Neruda's life history and its entanglement with the Chilean military coup of 1973. Neruda's house is now a museum where visitors can see his eclectic décor, unique architecture, and numerous collections. We also visited the beach and several members of the group played in the winter surf. On the way back to Santiago, we toured an eco-friendly winery and were taught how to taste wine properly.

The fourth day began early as we all headed back to the Santiago airport for an in-country flight to the small city of La Serena, which would be in the path of totality.

Let's try "glamping"

By the time the MPM was attempting to arrange our visit, every available hotel in La Serena had been booked. However, the tour company had found a contractor to provide "glamping" (glamorous camping) accommodations. The added benefit there was that we could stay at a higher altitude, thereby increasing our chances of enjoying clear skies

A version of this story also appears in the *Proceedings* of the 2019 Great Lakes Planetarium Society Conference in Toledo, Ohio.

on eclipse day. We piled into small buses and headed into the mountains along the "Ruta de la Estrellas," or the "route of the stars," which leads into the mountains and eventually to several observatories.

We were supposed to tour a dam that created a massive reservoir for local agriculture but were told en route that the dam was closed because of overcrowding. In retrospect, that was a harbinger of things to come.

We reached the small town of Vicuña and then turned onto a dirt road that carried us to our camp. It was a somewhat harrowing ride as the road seemed more appropriate for a 4-wheel drive adventure vehicle than a bus.

After several miles, we reached our camp. We were notified that the tents weren't quite ready yet but that we could enjoy lunch and some beverages at the outdoor kitchen while we waited.

The camp was set in a spectacularly desolate landscape, studded with only a few cacti and trees, and with no shortage of rocks and dust. The afternoon passed while we waited and continued to enjoy refreshments.

Late in the afternoon, Bob called us together. The sun was setting soon and we hadn't yet had our luggage dropped off or been told where our tents were. Relaxation turned to concern since we knew that the 80 degree day would soon turn into a cold, cold night.

Bob pressed our camp staff to give us access to our luggage and the group worked together to sort out the bags, while others in the group found piles of bedding materials and distributed them to our tents. Although it was chaotic, members of our group pitched in to help get everyone situated.

"A couple of hours away"

Our tents had been set up and there were air mattresses, but the promised electricity, heaters, bathrooms and running water were still "a couple hours" away. Dinner was served with more tasty beverages, but no progress was made in our accommodations.

That evening, we did have a spectacular night sky to enjoy. Bob led a star tour for the group and then we settled in for the night. The double thick air

mattresses were fairly comfortable. However, the thin blankets and the air mattress provided very little insulation that night as temperatures plummeted down near 40 degrees F. A heater sure would have been nice. At least my wife and I could keep each other warm and our air mattress stayed inflated. Others weren't so lucky.

It's the big day

The next morning was eclipse day! Some people in our group went on a guided hike, while others went horseback riding. After lunch, we began preparing for the main event. Telescopes, solar viewers, projection apparatus, and mylar glasses were deployed in anticipation of the eclipse.

All the while, a small number of workers continued to set up the bathroom/shower areas in our tents. Electricity was delivered, but not the running water. Each query got the same answer: "Another couple hours."

At 3:23 pm, we saw first contact in perfectly clear skies. There wasn't a cloud within 200 miles. Excitement built as the eclipse deepened and the landscape reddened. People tried pinhole projections, looked through the various telescopes and viewing apparatus, and took pictures of everything. Just before totality, we could see the hills in the distance darken as the Moon's shadow overtook us.

About 10 seconds before second contact at 4:38 pm, Bob hollered "take your glasses off!" to our group members. I am so glad that he did. During my first eclipse, I didn't know when it would be safe. This time, I was able to watch the crescent sun break apart into Bailey's beads. The beads disappeared one by one, until just the last one remained and the ghost-like corona revealed itself forming the diamond ring.

Totality is a glorious fury of both time dilation and frantic observation. Look with your eyes, then the binoculars or telescope. Should I try to take a photo and possibly waste precious seconds, or assist others with their observations, or just be selfish and bathe in the glory of the umbra?

I did a little of all that while my heart
(Continues on next page)



From top: The road case filled with observing gear. Next: The camp dining area. Photos by author. Next: Setting up our equipment prior to first contact. Photo by Amy Sparrow Percy. Bottom: The Astroscan fitted with a sun funnel. Photo by author.



Our intrepid group of eclipse chasers. Photo by Matt Heath.

stood still. It simultaneously felt like an eternity and the blink of an eye. There were such beautiful tendrils of light, like celestial hair. It was glorious beyond description.

And then the diamond ring again, and then more beads as the corona faded away. Third contact came all too soon, but we saw it, every bit of it, and it couldn't have been more perfect.

As the next hour of attenuating partial eclipse elapsed, the sun sank lower and began to disappear behind a ridge. This made for fascinating photos of a sun that was partially eclipsed by the moon and the nearby Earth at the same time. As the last bit of sun winked out of view, our hearts could finally return to their normal pace and we cleaned up our observing gear.

Electricity, but no heaters

The temperature had dropped from the upper 80s F to the lower 60s F during that past hour, and it wasn't going to get any warmer with nightfall. Our hosts finally admitted that while the electricity was on, there would be no heaters. I pestered them unrelentingly until we got more blankets for the coming night. One of the group members advised that cardboard from the scrap heap would help insulate us as well.

We headed up to the kitchen tent to celebrate over dinner and relax. The spectacular eclipse dulled our crankiness with our hosts for failing to deliver the creature comforts we had been promised. Then, the other shoe dropped. One of the bus drivers stood up and announced that they had not been paid and they weren't taking anybody anywhere until they got their money. Was this a scam? It seemed like their claims could be real because so many other things had fallen short. Piles of

unassembled supplies still littered the camp and the bartender started giving away bottles of pisco brandy. Things were really falling apart.

Bob and another group member, Gina, spent two hours negotiating with the bus drivers. The rest of us could only sympathize with Bob and Gina and hope for the best possible outcome while rumors circulated. Later that night, Bob told us that there would be no tours the following day as had been planned, but at least an agreement to "get us off the island" at 10 a.m. had been reached.

But—the skies were really dark

That night, a handful of us sat on hay bales and basked in the darkest sky I have ever seen. There was no point in calling out the meteors because there were so many. Centaurus, Crux Austrinus, bizarrely high Scorpius and the

Magellanic Clouds kept watch over us. We viewed Jupiter, Saturn and Omega Centauri with Bob's 6" Dobsonian and then I joined my wife in our much better insulated and now electrified tent.

The next day, 10 a.m. came and went. Then 11 a.m., and noon. It became clear that the deal with the bus drivers wasn't real. Were we stranded? Should we call the U.S. Embassy? How would we get out of here? Luckily and surprisingly, we had cell phone service the whole time.

One of our group members was able to find rooms for us to stay in La Serena that night, and Bob was able to get a bus from another company. We had to cram into camp staff vehicles to get to the bus because they couldn't reach the camp. Our luggage followed behind us in a truck as we worked our way back through Vicuña, past the reservoir, and into La Serena.

We piled into empty condos that had been vacated for the winter, took hot showers, and slept in real beds that night. Dinner was at local restaurants, where we found ourselves in the middle of soccer fan frenzy because Chile was playing Peru in the second semifinal game of the Copa America that evening.

The next morning, two smaller buses brought us back to the La Serena Airport. Back in Santiago, we all parted ways. This diverse bunch of 40 eclipse chasers had one hell of a story to tell. We also reflected on how well the group handled the adversity. If someone were trying to make a reality show, they would have been disappointed because we all worked to help and support each other the best we could.

After another redeye flight back to Toronto, we were back in the heat of the northern hemisphere's summer. Now we have stood in the umbra twice. I can't wait for the next time! ☆

(Chile, continued from page 14)

terparts in Chile and U.S.-based NRAO and NOAO facilities with the general public and K-16 students. Every ambassador has a new approach and fresh ideas for expanding the programs local and national reach.

By ensuring the public has an opportunity to learn more about the significant investment the U.S. is making in Chile, hopefully we can transfer our deep appreciation for the amazing discoveries being made and the monumental advancements in engineering and technology.

This summer planetariums everywhere can share these discoveries through the new full-dome film *Big Astronomy: People, Places, Discoveries* produced by the California Academy of Sciences. Enjoy Chile's grand observatories and meet the people who push the limits

of technology and what we know about the universe using world-class telescopes. Find out more by visiting www.bigastronomy.org/.

Acknowledgments

The authors wish to thank Tim Spuck and Yasmin Catricheo for their support, guidance and expert planning of the expedition. Thank you to the researchers, outreach coordinators and observatory executives for giving us a first-hand look at the facilities and for the informative and inspiring talks. Thanks also to Associated Universities, Inc. and the National Science Foundation for financial support of the ACEAP project.

Finally, we wish to thank all present and future Astro Ambassadors for their friendship, camaraderie and inspiration! ☆



MARS

ONE THOUSAND ONE

mirage^{III}D

8K

360°
FULLDOME

E&S



Carolyn Collins Petersen
Loch Ness Productions
Post Office Box 924
Nederland, Colorado 80466 USA
+1 303-642-7250
carolyn@lochnessproductions.com

Content distribution in a world without standards

IMERSA cordially invites IPS attendees to also spend some time with us at our first-ever IMERSA Day event. It will be held on Saturday, June 20th, 2020, at Telus World of Science. We are planning an exciting day, focusing on art in the dome, creative ways for fulldome storytelling, a close look at the latest video camera equipment and filming techniques, and a very special guest speaker from the entertainment industry!

This is your chance to meet with, talk to, and learn from producers and others involved in fulldome content creation! So, please consider joining us at IMERSA Day; you can register when you register for IPS itself.

This rest of this column is largely devoted to a topic that is near and

dear to the hearts of many dome professionals: content distribution, in particular, the question of encrypting our content for distribution.

Michael Daut, IMERSA board member, Giant Screen Cinema Association (GSCA) board member, and co-chair of the GSCA Innovations Committee, has been heading up the Association of Fulldome Innovators (AFDI). The AFDI is made up largely of hardware and software vendors and has taken on several tasks such as standardization for dome masters and other aspects of fulldome production.

Michael has written a column for us outlining AFDI's work, in particular a content encryption effort. He also has provided an exhaustive frequently asked questions document that answers questions that readers might have (starts on page 26). Take it away, Michael! ☆

The future of fulldome show distribution



By Michael Daut

Content distribution in the fulldome community is a challenging proposition. The fulldome world has created various dome orientations and projection systems, and the community has a complete lack of control over intellectual property management.

The lack of standards in dome theater configuration is daunting. Some domes have bases that are parallel to the ground, while some are tilted forward a little or a lot. Seats can all face toward the "front" of the dome (unidirectional) or can circle the theater's interior and face into the center of the dome (concentric), and seats can be on a level floor, sloped floor, or in a stepped (stadium-seating) configuration.

Additionally, there are a number of different digital fulldome vendors each requiring that dome videos be mastered, sliced, and encoded specifically for their proprietary systems, and in many cases specifically for each individual theater.

For both producers and theater operators, it can be difficult to find show license prices that make sense and is mutually beneficial and sustainable for the industry. This is a big topic and a source for a future article. We will save the deep dive into this subject for a later issue.

On top of all this, producers face challenges with the security of their shows once they are released to client theaters. With a few exceptions, the shows are completely unprotected. That makes it unprofitable and

unwise for producers to deliver shows to markets that don't respect intellectual property rights.

This article will explore solutions for coordinating fulldome content distribution safely, securely, and simply for all digital dome systems, opportunities for new licensing models, and tools for producers to easily provide encrypted content to theaters with more creative and flexible licensing models.

Standards are important

When comparing our fulldome realm with feature film distribution, which has long-established standards for content encoding, delivery, and encryption to serve their worldwide network of tens of thousands of theaters, the need for content delivery standards becomes self-evident. Numerous efforts have been made to rectify the situation beginning with the IPS Fulldome Standards summit at Valencia in 2004. It took nearly a decade of encouragement before the Association of Fulldome Innovators (AFDI) was founded at the IMERSA Summit in 2014.

Visionary leaders from Evans & Sutherland, Sky-Skan, SCISS, and RSA Cosmos came together to coordinate their efforts. AFDI invited other vendors and included Konica-Minolta, GOTO Inc., Front Pictures, Reef Distribution, D3D, Ohira Tech, Orihalcon Technologies, and Zeiss. Their goal was to find points of commonality where vendors could cooperate rather than compete. They believed that fulldome equipment vendors could develop, implement, and adopt standardization

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

for the betterment of the world-wide fulldome community.

Working collaboratively, the AFDI team defined and published a metadata standard for content delivery to distributors, film festivals, and other recipients who encode content for projection. RSA in turn produced an open-source app to prepare this metadata automatically. The metadata describe the number of frames in the show sequence, the proper frame rate, the audio format, image resolution, and other important information critical to its successful encoding and presentation on the dome.

Additionally, AFDI developed, published, and demonstrated a universal 2K video encoding standard that allows 2K-by-2K resolution fisheye videos to play on any and every digital fulldome video system in the marketplace, enabling producers to easily create trailers and complete fulldome screeners that can be encoded one time and then played back in any customer's theater, eliminating the need to do custom encodes for each individual system or individual theater, ensuring a wider reach for their content that producers can control themselves quite inexpensively. This standard can now be adapted to 3K-by-3K, and 4K-by-4K standards in the works. IMERSA has information about these efforts online at IMERSA.org.

Moving into encryption

Much of AFDI's efforts over the last five years have been focused on developing and implementing a cross-platform encryption standard to protect content from piracy and at the same time to incorporate digital rights management (DRM) features that will enable pay-per-view licenses, limited term licenses based on a number of plays, and reporting features to allow producers to learn how often a show is played in each theater. AFDI felt it was critical to collaborate on the development of one encryption standard for the marketplace in order for encryption to be useful, consistent, and uncomplicated across all vendor platforms. Individual encryption solutions from each vendor would have added exhausting complexity to an already daunting distribution system that requires too much custom encoding without the addition of an encryption solution. This "walled garden" model would have collapsed under its own weight.

AFDI has made great progress despite moving at a snail's pace. International team members have overcome conflicting work schedules, time-zones, languages, and cultural barriers to volunteer time to this effort. They have remained committed to progress and the team's goals have not wavered. This slow and steady progress has helped the team stay open to compatibility with the variety of complex hardware systems and sophisticated software used by the various vendors in this marketplace.

Fast forward to 2020, and the shared encryption specification has been adopted and published. AFDI vendors have agreed to move forward with implementation and working encryption solutions



An architectural drawing of a concentric theater where all seats face into the center. Content for these theaters often has a sweet spot in the top or zenith of the dome. Courtesy IMERSA.

will be demonstrated at the IPS Conference in June. Incidentally, the Giant Screen Cinema Association (GSCA) is also working on technical standards and best practices, and there is an excellent relationship between the GSCA Innovations Committee and AFDI. In fact, D3D, a digital dome theater system provider for the GSCA, is now part of AFDI, further extending the reach of our efforts. This incredible progress unlocks a future in which fulldome content can be prepared safely, securely, and simply for all digital dome systems, opening the door for producers to bring

content to theaters more easily and with more creative and flexible licensing models.

Next steps

At the time of writing, several AFDI vendors have fully working encryption systems, and those who do not are actively working on implementing encryption in time to demonstrate it at the IPS Conference 2020 in Edmonton. Extensive license key (known in the digital cinema world as a Key Delivery Messages or KDM) testing between the various vendor systems is beginning (the KDMs contain important data to authorize a show license at a specific theater for a specific amount of time), and a technical team with representatives from each vendor has begun regular meetings to monitor progress. The core AFDI team continues monthly meetings to address details related to business models, operational plans, database of site keys, and other logistics. We will begin work on a 4K-by-4K universal video playback specification, and then define our future goals in standards work.

AFDI will be presenting a workshop at the 2020 IPS Conference to demonstrate encryption and how it works on a number of systems. Some vendors are also planning to feature encryption in their trade show booths to give delegates a hands-on experience with it.

We know there will be many questions, and for a number of people in the fulldome world, this effort will come as news. To prepare for the conversations that will happen at the conference, this article serves as an encryption primer, a vision statement, and a series of Frequently Asked Questions and Answers. This is a big conversation, and the FAQ below is simply a starting point. AFDI's work will continue beyond these pioneering encryption efforts and will continue to help facilitate shared standards in the fulldome community to help ensure its bright future.

☆

(Continues with FAQ on next page.)

FAQ

Frequently asked questions about the AFDI proposal

Is this DRM or encryption?

AFDI has created a file encryption standard with DRM features in the license key (KDM). DRM features include a specific number of licensed plays, reporting to producers, the ability to renew a license with an updated KDM file. The encoded videos are encrypted and cannot be played unless they are loaded on a specific system and unlocked by a specific KDM.

Why does the fulldome community need this? How does it benefit all producers/distributors and users?

As content quality increases, the desire to have the shows also increases, and with this added perceived value, the temptation to use content without paying for it also increases at about the same rate. Producers spend hundreds of thousands or even millions of dollars to create fulldome shows, and it is critical to be able to protect this investment from piracy. As fulldome gains more visibility in the mainstream entertainment community (as it has already been doing), producers will expect that the fulldome systems will provide protection and security for their shows. Encryption is one path toward attracting more accomplished producers to create shows in this format.

The encryption key also allows the opportunity to provide licenses for a limited number of showings (a “pay-per-view” model) or a set period of time. This should facilitate exploring new distribution models other than the fixed price models that currently dominate the market. As the medium matures, it could also mean that a theater can potentially make more nimble, spur-of-the-moment purchases rather than going through a contracting process for each show.

Another interesting application of encryption lies with festival showings. Over the past few years, the number and extent of fulldome content festivals have grown. As part of IMERSA’s larger interest in such events, we are preparing a white paper on “best practices” at festivals. The paper includes an extensive discussion of content security requirements. This is where encryption can play a very positive role. With encryption encoded into files, producers can specify numbers of plays for a festival setting. For example, a two-day festival would require plays for judging, and then a specified number of plays for public presentation. This information is all easily inserted into the encryption key that the producer and/or their distributor encodes prior to sending the content to festival organizers.

What does DRM add to the producer/distributor/user relationship?

DRM takes the sting out of flat fee licenses that are either too expensive for some theaters or have to be discounted drastically to the point where the producer will have to wait many years to break even, let alone make a profit on their shows. This reality is one of the main deterrents to new productions getting funded, since the investment recoupment business model often does not make financial sense. DRM opens up “pay as you go” and revenue share license models that have been difficult to justify or manage in the past. This makes it easier for a theater to license a show to have on hand in their library and easier for the show to make money if it attracts an audience. In addition, festival organizers requiring encryption offer a higher level of content security

to producers and distributors who want to enter content into the festivals.

The shared encryption standard helps ensure that management of keys is limited to shows and theaters, not specific vendor systems that would all need separate show keys. Having separate incompatible encryption systems with each vendor would add a level of complication that would be very difficult to manage and would open the door to accidental incompatibility when a show was unintentionally mastered with the key for the wrong system.

Incidentally, shows have to be encoded anyway, and this happens every time a producer or distributor sells a license of a show. These encoding costs are built into a license or are charged as a separate line item along with the license fee. The encryption will be built into the encoding software from the various AFDI vendors, and should not add significant costs or extra time to the encoding process. The KDMs are small and can be produced and emailed for a nominal fee.

What does it take away from that relationship?

Encryption and DRM takes away the need for distributors to follow up on their clients to make sure they have stopped playing shows once contractual licenses have expired. It takes away many of the objections clients have regarding the price of shows. It also takes away the barriers that have historically prevented some of the more niche / artistic content from getting licensed. Essentially, there is only upside to adding the option for encryption and DRM to content.

What are the piracy statistics?

Digital piracy in film, TV, music, and e-books is a real thing. A recent article posted on cnet states “Global digital piracy costs the US film and TV industry at least an estimated \$29.2 billion and as much as \$71 billion annually, according to a new study from the US Chamber of Commerce’s Global Innovation Policy Center... That represents a revenue reduction of 11% to 24%. The study also says 230,000 to 560,000 jobs were lost because of piracy, which in turn resulted in the US GDP taking a hit of \$47.5 billion to as much as \$115.3 billion in 2017.”¹ Piracy is clearly a huge concern for Hollywood.

What is the extent of fulldome piracy?

Because the fulldome community has not established mechanisms for tracking piracy, no hard data on piracy exists. With that said, just as the larger entertainment industry has grappled with the problem of some users in some places having less respect for intellectual property than others, fulldome content producers face the problem, too. Some producers are unwilling to send shows to places where piracy is perceived as endemic. They know that if a show is shared freely in one of those areas, future income is lost, since clients in that market could get free access to shows without paying license fees. This is not a theoretical problem. There are specific examples of blatant piracy that could be cited and strong anecdotal evidence that piracy does exist in the fulldome community. There’s just very little or no empirical data.

Of course, we all know that piracy is going to continue. The better the content gets, the more it will be desired, and the more people will

(Continues on page 28)

¹ cnet.com/google-amp/news/digital-video-piracy-costs-the-movie-and-tv-industry-at-least-29-billion-study-says

BLACK HOLE

FIRST PICTURE

COMING SOON



EVANS & SUTHERLAND

Radboud University



FAQ, continued

want to pirate it, which just makes it harder for the folks who don't pirate and who do play by the rules. Encryption offers a way to satisfy producers and attempts to keep honest people honest by making it difficult for pirates to be devious.

Once we have a system out there, there will be efforts to break it by those who simply crack code as hackers. What have we done to avoid that?

This answer is not what we want to hear, but the question cuts to the core of the issue. Those who are dedicated to hacking will likely find a way to break the encryption in some way. However, the specification implements state-of-the-art encryption technology to make the software as secure as possible. The software will undoubtedly need to be updated on a regular basis to keep hackers at bay.

Also, by nature of the fact that the specification takes into account

What will it cost me as a producer/distributor to apply DRM to all the videos I send out? How much time will this take?

We don't have pricing available yet, since this will be determined by the equipment vendors, producers, and distributors; however, we would expect a modest up-charge to the standard encoding fees.

An important note, that we will restate later in this FAQ, is that all vendor systems can play 2K-by-2K fisheye video encodes (using the spec that AFDI defined). Most, if not all, vendor systems today can play 4K-by-4K fisheye video encodes. This means that a single high-resolution 4K fisheye video encode of a show could essentially play on **all** vendor systems, greatly simplifying distribution and dramatically lowering the overall cost of encoding, since any given show will only have to be encoded one time. Even 8K systems can play back a 4K video and have it look exceptional.

Who is going to explain this to our clients and get them to accept it?

This article is one step toward informing the marketplace about encryption and DRM. The equipment vendors, producers, and distributors will also need to help clients understand what this means and how the technology works—and it is important to emphasize that this technology can make access to shows easier and more affordable than it is now. AFDI will consider ways we can also help spread the word and help the community understand and accept these efforts, along with the need for and benefits of encryption and DRM in fulldome content.

Who's going to be the "help desk" when things go wrong?

Because each equipment vendor will be implementing encryption and DRM into their respective systems, the vendors will be expected to support clients when they have issues playing back encrypted videos. However, if a distributor chooses to encode, encrypt, and create a KDM for a show, then they will be responsible to support the client (or pay the vendor for support). The vendors will need to provide the distributors with comprehensive documentation to allow distributors who are authorized to encode and encrypt to effectively support and troubleshoot any problems with encoding, encryption, or KDMs.

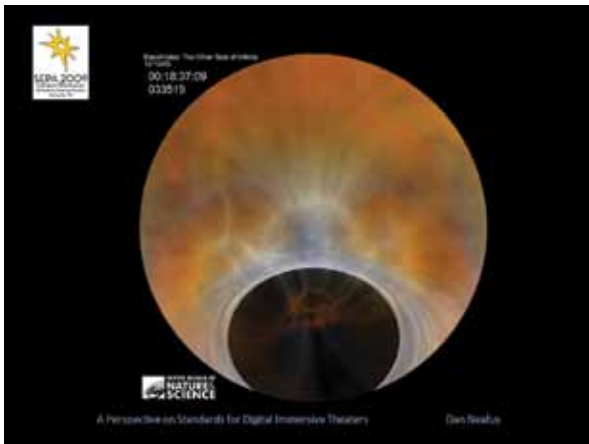
Equipment vendors have begun extensive testing with the encryption software to ensure that KDMs they create will be compatible and interoperable with content on all systems using the AFDI specification.

Will this DRM package and implementation increase the cost of shows?

Yes, but perhaps not by very much. The cost of software development will need to be recovered by the vendors, and the cost of encoding and encrypting and KDM creation will need to be recovered by those who do this work. The good news is that encoding software already exists and is already available from most vendors. Encryption capabilities will be added to existing software, and the extra time to encrypt and encode versus just encoding without encrypting is not significant (which keeps additional costs down).

Vendors and distributors will need to decide how much to charge for an encrypted encode vs. a non-encrypted encode and then pass these costs along to their clients. With that said, once 4K-by-4K playback is implemented by all vendors, then a single encode can be done by the producer or their distributor, and then duplicated (for a fee) and a KDM created for each venue, thereby reducing the amount of encoding work needed and effectively reducing the encoding and encryption costs overall from where they are now.

(Continues on page 30)



A sample dome master created using AFDI standards. This is from the Spitz Inc./Denver Museum of Nature and Science fulldome video *Black Holes: The Other Side of Infinity*. Courtesy Denver Museum of Nature and Science.

existing system architecture, it is not a completely locked system. This makes the encrypted files themselves accessible from the computer hard drives, putting responsibility on the theaters to secure content loaded onto their systems.

The AFDI specification has made the encryption as secure and hack-proof as possible. However, no software, no matter how well engineered is absolutely unbreakable. With that said, by design, it will be very difficult for hackers to break through the encryption.

What's to keep someone from inserting a digital recorder somewhere in the stream between computer and projector and recording the movie file?

Nothing. There are two types of recording: one is from a camera in the theater, and given the size of a dome, an iPhone will not be able to capture everything, and most theater patrons are not bringing a Canon Mark II with an 8mm fisheye lens into a planetarium when they watch a show. Even if they did, the quality would be quite rough.

The other is a digital recorder as stated in the question and is a valid concern. We are looking into how HDCP technology may help prevent the signal from working if it is diverted from its original path.

If piracy could be completely stopped by encryption, there would be no more piracy. This is not a perfect solution, but neither is the encryption methodology outlined by the DCI specification. Hackers gonna hack.

A DAZZLING NEW SHOW FROM THE HAYDEN PLANETARIUM

WORLDS BEYOND EARTH

Narrated by
LUPITA NYONG'O

AVAILABLE TO LICENSE

amnh.org/fulldome
mheenan@amnh.org

FAQ, continued

So, where is the profit margin in doing several hours' worth of work to encode a video that will get played 25 times for, say, \$500—or \$300? Those hours basically are free work by distributors and producers who are already being squeezed. If we have to spend money to get this digital encoding system, when/how does it pay for itself?

A single 4K-by-4K encode that can be used for every client solves this problem quite elegantly, since the cost of encoding can be amortized over every license sold. And for lower resolution systems, that economy of scale will be in place immediately.

What do we do about all the shows that are already out there in the wild?

This falls under “growing pains.” Clients will not need to have all of their current shows encrypted, and the AFDI specification does not require encryption for all content. Unencrypted shows can continue to play on a system that supports playback of encrypted content. For existing files, clients may choose to upgrade to encrypted versions of the shows, or these can be replaced when a client renews a license, or these files can be deleted once a license expires. This is also an opportunity to explore other solutions.

What if a system doesn't support DRM? (There are many such examples, including warped mirror domes and home-built systems.)

As mentioned above, content does not have to be encrypted. However, in the future, some producers may start requiring this in an effort to protect their content. Should this happen, systems that don't support the AFDI specification may not be able to play shows that require encryption. This may encourage vendors who don't support encryption to reconsider implementing this capability into their systems.

What happens when a theater upgrades to a new resolution?

This is a business decision on the part of the theater and the distributor or vendor. Any existing content should play in 2K-by-2K from a fisheye video on the new system. However, should the theater want their shows in a higher resolution, the theater should be expected to pay for new encodes (or the vendor may choose to replace them at no charge or for a small fee).

What happens when a theater buys a show from one producer/distributor, but in the future wants to get a higher-resolution version from another distributor? (For example, if someone bought a 2K show from SCISS or RSA and now wants to lease a 4K version from a company such Loch Ness Productions or E&S or Zeiss?)

Once a 4K-by-4K fisheye universal video spec is established, this becomes moot, since all systems will be able to play this regardless of the vendor. At the same time, and until the 4K spec is more widely used, if the client requests something, they should be expected to pay for the product or service, since companies are in business to produce revenue.

What happens when a facility gets rid of their old system and gets a new one from a different equipment vendor?

Same answer as above. Similar logic applies here as well.

What happens when a theater licenses a show that is encrypted, but their IT department refuses to allow the key to be used?

These are issues that should be thoroughly discussed between a theater and their IT department prior to upgrading their system to include encryption and DRM capabilities. Before a theater upgrades their system, this requirement should be well understood by all parties within their institution.

What if an equipment manufacturer refused to allow the encoding, saying it will break the warranty?

AFDI will make every effort to provide transparent documentation for the encryption product so that equipment vendors will understand what is being installed on their clients' systems.

How do we handle shows that are not encrypted but users want to play on their systems?

The AFDI specification does not require files to be encrypted, so this is a non-issue. Unencrypted files will play just fine as they always have.

What if an equipment manufacturer wants to use the encryption to create a walled garden so that no one can put shows on their systems but them?

Their systems would not then be compatible with the AFDI specification and would have difficulty using standard content. This will increase complexity and costs for this vendor who will have to support their system in an isolated and unsustainable ecosystem.

So, say we all use DRM to sell “per plays.” How are prices determined for show plays? What issues face us for pricing?

AFDI is not in the business of recommending show pricing. The price will be determined by the show itself, the theater's metrics, the producers and distributors, and a number of other factors. The endemic issues of price sensitivity in the fulldome community will remain, at least for the time being, and hopefully creative licensing models facilitated by DRM will encourage theaters to license more content with less risk of a large up-front fee.

Do you have additional questions?

We have attempted to answer the most important questions regarding encryption and DRM in this article. We invite readers to contact us with additional questions at info@IMERSA.org, and as many questions and answers as possible will be published in a future issue of *Planetarian*. ☆

“Space is for everybody. It's not just for a few people in science or math, or for a select group of astronauts. That's our new frontier out there, and it's everybody's business to know about space.”
— Christa McAuliffe

Details, details, details

This close to the surface, details matter. Overlaps, crimps, folds, and exposed rivets will affect your image. Perfect projection is only possible with a perfectly uniform surface. NanoSeam™ has no irregularities in the surface. None. It's why the most prestigious venues choose Spitz domes - including The Adler, The Hayden, and our partners like IMAX, Disney, Universal Studios, and Seaworld.

NanoSeam

SPITZ Domes

World's Leading Domes



www.spitzinc.com



Jeanne E. Bishop
Westlake Schools Planetarium
24525 Hilliard Road
Westlake, Ohio 44145 USA
+1 440-871-5293
jeannebishop@wowway.com

How gender affects learning

As we present a planetarium program or classroom lesson, how our efforts are perceived by each individual depends on many things. In my last column, I explored the importance of words. Here I want to examine the factor of gender. I'll look at research-based conclusions and then discuss some implications for the planning of programs and lessons containing our (almost always) mixed audiences.

In my dissertation work with eighth grade students (age 13), I determined that there was a statistical difference in general spatial ability between males and females, a feature which is, of course, important to learning astronomy and interpreting visual aspects of planetarium demonstrations.

This does not mean that individual girls do not have superior spatial skills or that individual boys have great spatial skills. It is just a generalization. There are other brain differences as well, which lead to differences in learning.

However, as international consultant in educational neuroscience David Sousa points out, just because we find differences in gender learning, this does not mean that a judgment should ever be made that one gender has a brain that is better than another.

Differences found by researchers

Gender differences in brain learning have been explored by many researchers. Some differences have been identified with differing brain structures and development. The "gray matter," a thin cortex layer with most mostly dendrite neurons, is distributed differently. Generally, females have more total gray matter, but males usually have more gray matter in the left hemisphere.

Females usually have a larger and thicker cable called the "corpus callosum" that connects the two hemispheres, which means that in female brains there is greater interaction between the two hemispheres.

Females process language mainly in the left hemisphere, but also have large language regions in the right hemisphere. The density of neurons in language areas is greater in females than in males. This structure difference supports the idea that girls' brains are better at communicating information between hemispheres and boys' brains are better at processing information within each hemisphere. These differences may explain why females usually recover faster and more completely from verbal impairment in strokes.

The amygdala, which responds to emotional stimulation and has a large number of testosterone receptors, grows faster in teenage boys

than in teenage girls. In adult males, the amygdala is larger than in adult females. This may help explain why adult males often are more overtly aggressive than females.

Research shows that females remembered details of an emotional event better than males, while males remembered the main aspects of the situation better. Possible this is due to the fact that in PET (positron emission tomography) scans taken during emotional stimulations,

females tend to activate the amygdala only in the left hemisphere while males tend to activate the amygdala only in the right. The left side of the brain normally is responsible for remembering details, while the right side operates in a more simultaneous, holistic way.

The part of the brain called the hippocampus, responsible for memory formation and consolidation, filled with estrogen receptors, grows faster in girls than in boys during adolescence. Possibly this explains why young girls generally are better at language, arithmetic computations, and tasks that involve sequence, since these depend on efficient memory processing.

As in my planetarium research with 13-year-old students, research by others show that males normally are better than females on spatial tasks. These include mentally rotating 3-dimensions bodies and spotting shapes embedded in complex situations and diagrams.

Research reveals that females perform better on tests of perceptual speed, verbal fluency, determining sequential placement of objects, precision manual tasks, and arithmetic calculations.

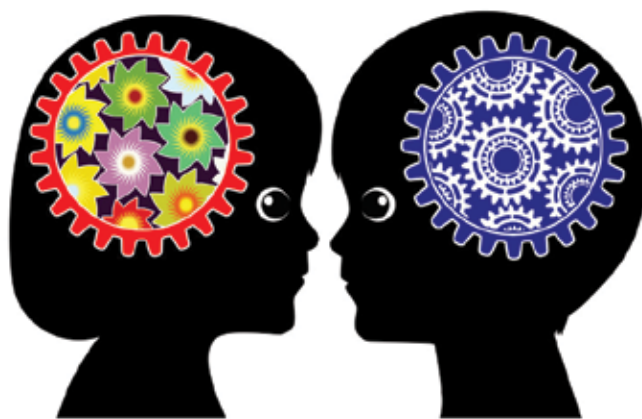
After summarizing a large number of research studies, David Sousa makes the point that there is no difference in overall cognitive performance between males and females. He says that research evidence suggests that the reasons for brain gender differences can be found in the influence of prenatal hormones, natural selection, and environment.

So should planetarium and astronomy educators ignore the brain gender difference in the interest of "political correctness," and consider only other factors important in learning? Or should we embrace this information, and without necessarily mentioning it to our mixed audiences, apply what brain research has revealed?

Pay attention to age-related abilities

Behavioral research on cognitive development has shown that there are large changes in thinking abilities with advancing age. The research of Jean Piaget and subsequent work by many others shows differences in abilities that I think are more important for planetarium educators to consider than gender difference as they work with children of different ages, adolescents, and adults.

The more we know about learning, the better we can be as planetar-



Can Stock Photo/Sangoiri

Jeanne Bishop is a past president of IPS and chairs the Education Committee. She is retired from full-time planetariums work and teaching, but maintains the position of Westlake Schools Planetarium director.

ium and classroom communicators. I think that we should understand and apply the research conclusions of both gender brain research and cognitive development.

So what practices might we employ in a planetarium program that recognizes and uses gender brain research?

Suppose we are presenting a lesson about lunar phases. There are language and visual components. Although not usual, an emotional component also can be included.

Remember that females generally are better at sequential memory and identifying specific attributes of objects than males. That means that details of the appearance of each moon phase and differences in the phases as the moon throughout the month probably will be perceived faster and better by girls than boys. Remember, too, that females generally are better at verbal fluency than males. So careful description along with a visual demonstration of phase changes is an optimum teaching procedure for the girls.

How will boys' brains respond to this? No doubt many boys also learn reasonably well from this practice. But boys tend to remember the central aspects or gist of a lesson. That means that a "nutshell" conclusion of what was demonstrated and discussed is exactly what the boys are individually processing. For the planetarium teacher to take a substantial amount of time to elaborate on the gist of the narrated demonstration, perhaps in an interactive way with students, greatly supports the boys' brain preferences, or as Piaget would have said, "happy assimilation." And because girls often are less skilled with holistic conclusions, forcing them to think in a less-preferable way, they will, as Piaget would have said, "learn by accommodation."

Suppose that in this planetarium lesson you present a diagram or a change in location in an immersive experience explaining the reason

for lunar phases (the view from outside Earth). Most of us do this for students from about age 7 upward. Note that, depending on the age of students, neither boys nor girls may be able to coordinate the back-and-forth mental process needed to understand why the space-based view explains the Earth-based view. However, since boys generally have better spatial abilities, they are apt to more easily understand the relationship.

When using the diagram or the immersive change-of-position, I recommend using increased narrative time to explain the details of the diagram or the changing perspective. Perhaps presenting a variety of orientations of a diagram, identifying sun direction, Earth, light and dark halves of the moon in each position, and the resulting phases for each position can be very helpful (but confusing if done too quickly). This exercise should help more girls, who have language and object-detail skills to develop understanding.

I believe that an emotional or self-reflective aspect of even a very basic lesson like lunar phases should not be ignored. The amygdala brain structure in both males and females in a powerful former of memories. In the example lunar phases program, I suggest that we might add music, poetry, a simulation of being outside with attendant sounds, and/or discussion of how students saw or plan to look for moon phases outdoors.

I hope that we consider a large number of factors in planning and presenting our shows and lessons. But brain gender difference should not be ignored if we want learning to be as successful as possible.

Reference

Sousa, David A. *How the Brain Learns*, Fourth Edition. 2011. Corwin Publishing ☆

P R O J E C T O R S / C O V E L I G H T I N G / D O M E S / S E A T I N G

WARPED MEDIA 2K DIGITAL PROJECTOR—FULL DOME PROJECTION AT A REASONABLE PRICE

SPITZ PROJECTORS REPLACEMENT LAMPS: LED Star, Sun, Moon and Planet*

PERFECTING PLANETARIUMS

OM Star Projector Maintenance

Installation of Seating

Audio Systems

Cove Lighting

Dome Cleaning & Painting

4K, 8K and Hybrid Industry Partners
with RSA Cosmos and GOTO

* Under development for 512



ASH-ENTERPRISES.COM • 804.543.2499





Mark Percy
Williamsville Space Lab Planetarium
1595 Hopkins Road
Williamsville, New York 14221 USA
mpercy@willamsville12.org

A classdome cadre takes over

Welcome to Classdome!

Before I introduce myself, the first thing I want to do is thank Jack Northrup for his years of fascinating columns under this title. His work is another example of what I always tell my administrators and colleagues at school: my fellow planetarians make me feel like a lazy idiot!

It is not that I really think that I am (a lazy idiot). We do some pretty great stuff in my dome and my visitors are duly impressed by our programs. But then I go to a conference or read *Planetarian* and I realize how much more I could be doing. Everyone that I interact with in the planetarium sphere (or perhaps hemisphere) is amazingly creative, brilliant, and hard-working. Jack's columns have inspired me to do more and better things each time *Planetarian* arrived in its hefty envelope. Thanks again, Jack!

I have long felt that I should be doing more to contribute to the planetarium community. Sharon Shanks heard me and now I have an opportunity to help share great ideas with others by curating this column. Sharon didn't ask me to do it alone. That could have seemed too daunting to accept. Instead, she rounded up a group of other amazing teachers who work in classdomes and asked me to work with them to continue this column. I'll introduce you to them briefly later in this article. For now, I want to share some of my background and let you all get to know me a little better.

At the Williamsville Central School District

My planetarium is part of the Williamsville (New York) Central School District. While it is attached to North High School, I serve PK-12 students from all of our 13 district schools as well as any interested schools from the region. Most of my visitors are from other schools and are fairly evenly distributed across the grade levels.

I also run evening programs for the public through our school district Community Education program and have three part-time presenters, along with two high school students who work with me as student assistants. Other than that, I am a one-person operation. I do all

the scheduling, promotion, program acquisition and creation, maintenance, and (most importantly) teach all the planetarium lessons.

I began my career teaching mostly chemistry and a little earth science for 9 years. I have been involved with theater technology since high school and happily took on the role of Stage Crew Advisor in my first year at the school. As my planetarium predecessor approached retirement, I realized that working in the planetarium would be a great way to both teach science and use my aptitude for technology.

I brushed up on my astronomy and transferred into my current position in 2001.

That is how I got here, but what am I and what is my place in the educational universe? I am still a classroom teacher. I see kids and interact with them face to face every day, but now I see thousands of different kids every year instead of the same ones each day. I also don't get to rely on a state mandate to bring my students

to me. I need to make my lessons so engaging and worthwhile that their regular teachers will bring them voluntarily. With all their day-to-day responsibilities, their time with me had better be a "wow" experience or they won't come back. Luckily, everyone loves astronomy and my classroom has a lot of "wow" to offer.

When I started in the field, our planetarium had slide projectors and a myriad of special effect contraptions. It was a lot like what I was doing in the theater: electronics, dimmers, smoke and mirrors (with hopefully very little smoke). I learned to opaque slide film by hand and created a few of my own shows. I feel that this was very valuable experience for me to have.

However, the nature of my work changed fundamentally in 2007 when we invested in our fulldome video system. Some of the paradigms still hold true, but much has changed. Now I spend my days grumbling at computer monitors instead of painting slides and coaxing special effects to continue working.

Despite this fundamental change, my mission is the same and my core values as a science teacher are still what guide my work. I believe that the planetarium is most fundamentally a place for science. We do

ca•dre
/'kadrē, 'kădrē, 'kad, rā, 'kăd, rā/
a small group of people specially trained for a particular purpose or profession



Peggy Hernandez



Geoff Holt



Anthony Kilgore



Neil Pifer



Lisa Swaney



Rob Webb

lots of other stuff—mythology, history, art, and so forth—but my main purpose here is to communicate to children what science is and how the universe works.

I also expect respect from my students. I meet them at the door with a friendly greeting and direct eye contact just like I would when I was teaching classroom chemistry. I also know that questions and discussion are a fundamental part of the learning process, and I do that with the students at every possible opportunity. And really, that is the fun part. Making the magic happen on the dome is great, but answering the students' questions, unraveling their misconceptions, and exploring their ideas make my day every day.

I also understand the broad impact that a planetarium has on a community. I have built a public outreach program with the help of my evening instructors. We teach the public about the constellations, stars, and the latest astronomy news. We provided an opportunity for hundreds of people to view the transits of Venus and three partial eclipses, and I am working with several other local institutions to prepare for totality in 2024. We are right in the path and will have 3 mins 51 secs of totality right in my parking lot! I am doing my best to get us ready and make sure that everyone knows how to view it safely, and I have fellow planetarians to thank for inspiring me to do everything I can to achieve that goal.

Introductions are in order

Now I would like to introduce my cadre of classdome teachers. We have been getting to know each other as I prepared this article. As each of them is featured in future editions, we'll get to know them better.

- Peggy Hernandez, planetarium teacher, Elgin Planetarium, Elgin School District U-46, Elgin, Illinois, USA
- Geoff Holt, planetarium director, Madison Metropolitan School District Planetarium, located in James Madison Memorial High School, Madison, Wisconsin, USA
- Anthony Kilgore, planetarium director, Irene V. Hylton Planetarium, located at C.D. Hylton High School, Woodbridge, Virginia, USA
- Neil Pifer, K-12 science specialist and planetarium director, Margaret C. Woodson Planetarium at Horizons Unlimited, Rowan-Salisbury Schools, Salisbury, North Carolina, USA
- Lisa Swaney, planetarium director, Horwitz-DeRemer Planetarium, Waukesha School District, located in Retzer Nature Center part of the Waukesha County Park System, Waukesha, Wisconsin, USA
- Rob Webb, Pequea Valley Planetarium, Pequea Valley Intermediate School, Kinzers, Pennsylvania, USA

I am really looking forward to working with these wonderful folks to share strategies that we use in our unusual classrooms.

Kinesthetics in the classdome

Before I wrap this up, I need to share something useful from my own classdome. One of the techniques I have been using lately is kinesthetic learning. Audio-Visual Imagineering's *The Moon* got me started with this technique. In that program, the kids point at the moon and follow it across the dome from moonrise to moonset. I definitely noticed that the kids could recall whether the moon rises or sets in both the east and west better after having engaged in this simple exercise. I have thought about some other ways to apply it and come up with a few that I'll share.

The first was simply to have the high school kids do the same thing in their earth science lab about the moon and its motions. It is tougher to get them to actually raise their arms and follow it because they are so self-conscious at that age, but some humor works. I tell them that

kin•es•thet•ic

/ˌkɪnəsˈTHedɪk/

adjective, relating to a person's awareness of the position and movement of the parts of the body by means of sensory organs (proprioceptors) in the muscles and joints

their mom probably told them that it is not nice to point and make fun of things, but this is OK because we won't make fun of the moon.

These kids also seem to better recall the direction from which things rise and set. I think that the mere fact that they have to hold their arm up keeps their attention more focused on what we are doing, rather than whatever else might be on their minds.

I also started applying this to the motion of the sun, but with some additional questioning to extend the idea. After they follow the sun across the dome, I ask them "If your arm were the arm of a clock, which way is your arm moving: clockwise or counter clockwise?" They get that one right just about every time. Then, I ask them what the first technology was for measuring time. After a few random answers, they'll come up with the sundial. I then use my own arms to demonstrate how the

gnomon's shadow would move across the ground and ask them again which direction it moved.

Then I explain to them that when the first clocks were made, the inventors didn't just flip a coin to decide which direction the hands should move. What they did was mimic the motion of humanity's original time piece, the sun. I also then remind them that



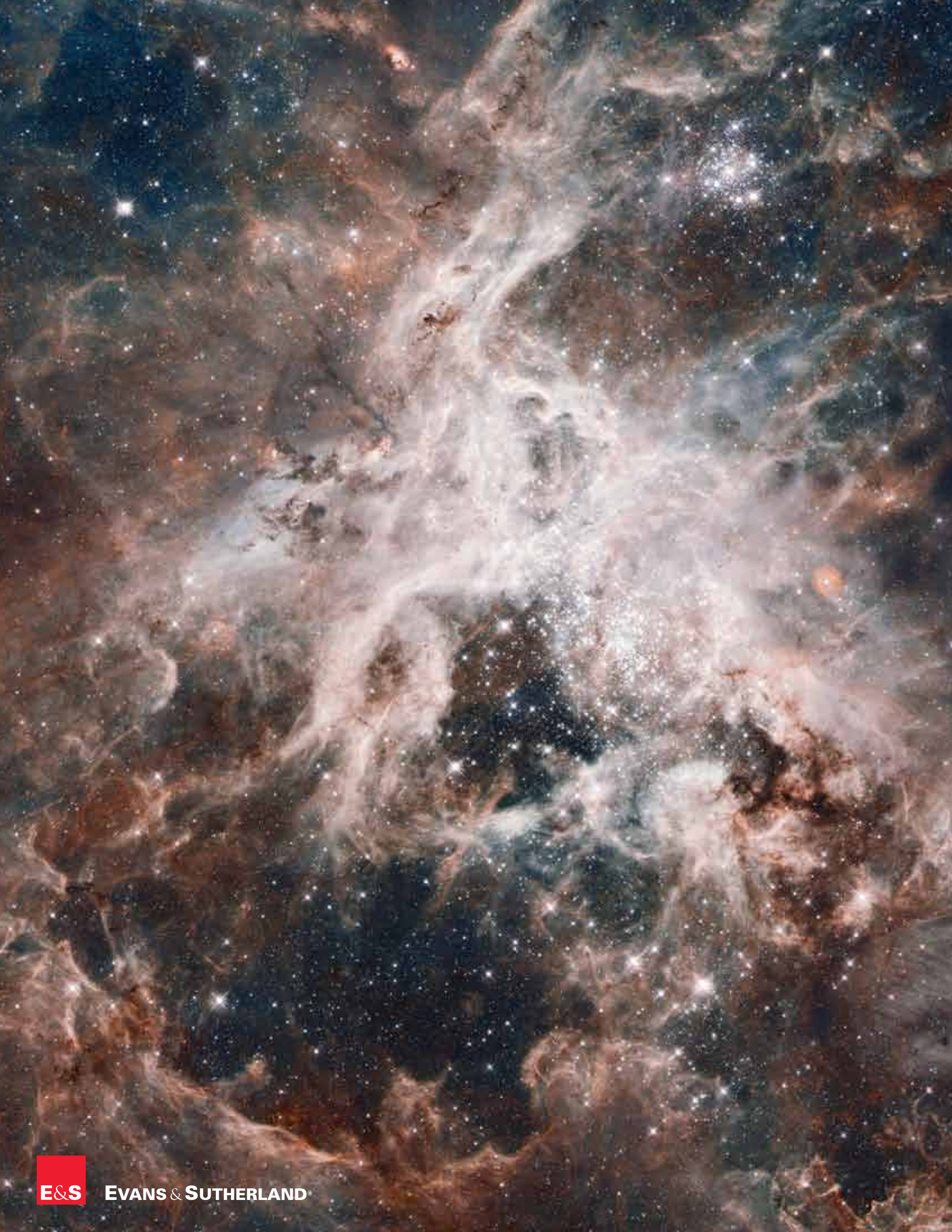
Kids pointing at the moon, photo by the author

the sun moves across the southern sky. Next, I ask them what direction they think things move if we look in the direction opposite of south. Some guess clockwise and others guess counterclockwise and then we observe some northern diurnal motion. Lo and behold, when you look in the opposite direction, you see the opposite motion!

The third way I have figured out to involve the high school kids in some productive pointing involves identifying compass direction from star trails. I demonstrate some diurnal motion for them and ask them to look around and what is happening in each direction. Next, I turn on the star trails and ask them to observe. They really like the star trails, so I play it up by asking them for an "oooooh" and maybe even an "aaaah" if they like the effect.

I also use a little more humor to get the words "circumpolar motion" to sink in by asking them to say it back to me, and then do so again in their best British accent. (Everything sounds smarter with that accent, right?) I tell them how smart they sound and dare them to slip that terminology into conversation with their parents that evening and watch their parents' reaction.

(Continues on page 47)



EVANS & SUTHERLAND

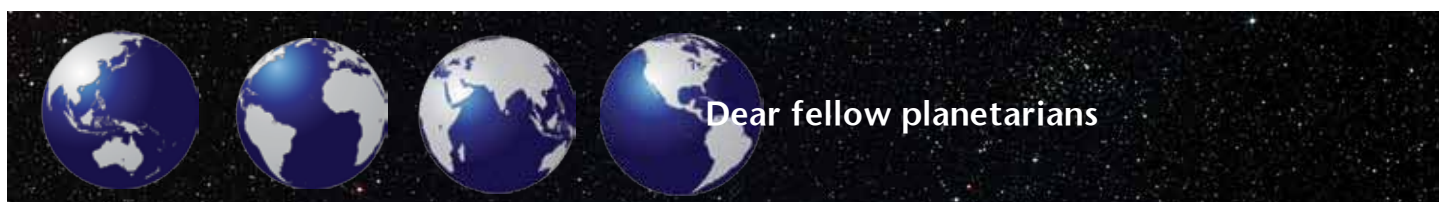
DIGISTAR 7



EXPERIENCE WONDER | IPS 2020



Lars Petersen
DK-6630
Rødning, Jels, Denmark
lpsd@jels.dk



As usual, this column is filled with inspiring news from all over the globe. New planetarium shows are created, top researchers from astronomy and space science give lectures, new equipment is installed, and planetarium staffs are as busy as ever. It is also interesting to see how art plays an important role in many of the activities under the domes.

For this section I'm indebted to contributions from John Hare, Ignacio Castro, Bart Benjamin, Anna S. Arnadottir, Zinaida Sitkova, Alexis Delivorias, and Loris Ramponi.

Let's start this tour around the world by the Gulf of Mexico.

Southeastern Planetarium Association

The Southeastern Planetarium Association's 2020 annual conference will be held at the Hallstrom Planetarium on the Fort Pierce campus of Indian River State College on Florida's Treasure Coast 2-6 June. For more information contact Hallstrom Planetarium Director Jon Bell at jbell@irsc.edu. Conference information is also available at sepadomes.org.

The planetarium features a 40-foot, 12-degree tilted dome, 74 seats, and is equipped with both optical-mechanical and full-dome digital projection systems.

SEPA will return to Kingsport, Tennessee in 2021 for its 50th anniversary conference. The facilities at Bays Mountain Park include a recently-renovated planetarium situated in a 3550-acre nature preserve. Planetarium Director Adam Thanz emphasizes that this is the third SEPA conference to be held at Bays Mountain.

Sites interested in hosting the 2022 SEPA conference should prepare an invitation to be submitted to SEPA no later than the 2020 conference.

The SEPA 2023 conference in Nashville, Tennessee is in the planning stages. Tentative plans include a U.S. National Conference to be hosted by the Sudekum Planetarium. Further information, as it becomes available, will be posted on the SEPA Website.

For any and

all information regarding SEPA, please visit the website sepadomes.org and/or contact the SEPA IPS representative John Hare at johnhare@earthlink.net.



AMPAC. Planetario Citlatepetl under construction and an illustration of the planetarium façade when finished. Both courtesy of Enrique Fonte, Planetarios Digitales.



Association of Mexican Planetariums

On 21-22 November, AMPAC celebrated its annual meeting and XXXIX General Assembly in collaboration with the Chimalhuacán Digital Planetarium in the State of Mexico with participating representatives from 15 Mexican planetariums.

The meeting was highlighted by the attendance of Sharon Shanks, *Planetarian* executive editor, who presented a paper titled "Under One Dome," which later appeared printed in her column "In Front of the Console" in the December 2019 issue. The attendees were moved by her motivating words: "One of the strengths in the planetarium community is our ability to use empathy, our shared heart, to stand strong against a world that does not understand the value of our domes and the wonder it opens to people's minds (especially children)." And also, about planetariums being inclusive "because, after all, we work in the dark, and that eliminates differences".

Julien Potier held the presentation titled "Chemistry of Disclosure"



AMPAC. Sharon Shanks, *Planetarian* executive editor, receiving a recognition for her participation at the AMPAC meeting from Chimalhuacán Planetarium authorities and AMPAC officers.

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

about how the diverse chemical elements transform and fuse as related to the universe we know and to ourselves, since we are made of elements, too. The participants enjoyed viewing the premiere of the dome movie *Universe of Elements*.

AMPAC's thanks go to Chimalhuacán Digital Planetarium director Miguel Augusto Olivares and his staff, for their warm welcome and for the enjoyable Mexican folk dances by a local professional dance school group.

On other news, many planetariums and science museums and archeological sites participated in the yearly Night of Stars 2019. The Jalisco Planetarium and Interactive Science Center, Lunaria, celebrated its first anniversary, on 17-22 December by carrying out diverse activities on diffusion and public communication of a scientific culture. There were special emphasis on 3D Dome presentations and a prime lecture by Dorian Sagan, son of the celebrated astronomer Carl Sagan and Lynn Margulis, reknown U.S. biologist, under the theme: The humane dimension of Carl Sagan and the Mexican connection of Lynn Margulis.

Great news have just reached the association from Enrique Fonte representative from Planetarios Digitales. The Citlaltépetl Planetarium located in the city of Orizaba, in the State of Veracruz is a cutting-edge project developed by the Planetarios Digitales company, which will have regional influence in the eastern part of Mexico and will be at the level of the best planetariums in the world.

The projection room will have a screen of 12 meters in diameter and a capacity for 90 people; With equipment of four Native 4K laser projectors, it will offer very high-resolution images and excellent quality thanks to its latest generation Digistar 6 System. The planetarium will open its doors in the first months of the second half of 2020 and will be a boost for the science, art and culture of the population of Orizaba.

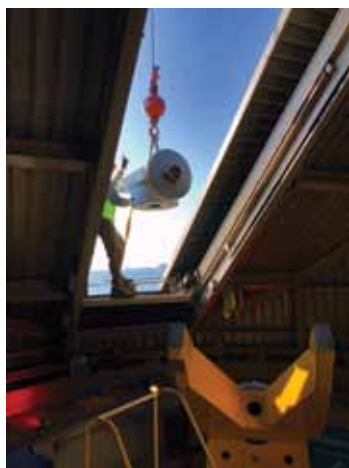
Great Lakes Planetarium Association

Illinois. At the William M. Staerkel Planetarium in Champaign, the James B. Kaler Science Lecture Series continues with talks on supermassive black holes, tornadoes, and birds of east central Illinois. Producer Waylena McCully and instructor Julie Angel are revamping their plate tectonics presentation for potential use as a school program. Other projects include a series of special event programs in Spanish and developing sensory-friendly options for several of their shows.

This winter, the Dome Planetarium in Peoria offered several special events—Pub Night, Wine and Cheese and Romance Under the Stars programs, as well as Laser Light Nights and Space Family Nights, which focused on current lunar exploration and planned missions to Mars.

At the Strickler Planetarium, Bourbonnais, the staff is still learning their new Digistar 6 system, which was installed this past summer. In December, they ran their own live show called *Skywatch Live* that featured an interactive tour of the universe with a focus on the winter skies. In November, they hosted an observing event on campus for the transit of Mercury that drew about 50 people, despite uncooperative weather.

Chicago's Adler Planetarium has replaced the primary telescope in its



GLPA. Left: Removal of the 20-inch Cassegrain telescope at Adler's Doane Observatory. Below: the new 24-inch telescope installed in December last year. All photos courtesy of Adler Planetarium.



Doane Observatory. Their old 20-inch diameter Cassegrain reflector and mount have been removed, and the new telescope is a 24-inch corrected Dall-Kirkham from PlaneWave Instruments.

The seventh and final Kavli Fulldome Lecture was presented in November and featured Drs. Chris Lintott and Laura Trouille of the online citizen science platform, Zooniverse.

In November, Adler After Dark featured two sold-out performances of *Sphere*, a fulldome performance featuring live music paired with dramatic space-inspired visuals.

Indiana. The Koch Immersive Theater and Planetarium, Evansville offered a public viewing of the transit of Mercury on a hillside overlooking the Ohio River at sunrise on 11 November. An Astronomy/Science Day was recently held at the museum and two girl scout badge evenings occurred, with over 100 girls attending.

Michigan. In August, the Grand Rapids Public Museum's Roger B. Chaffee Planetarium welcomed a new presenter, Stephen King. The team has been developing their core product of live planetarium content, including their "Space News" introductions. They continued their "Concerts Under the Stars" series this winter. In September, the Grand Rapids Amateur Astronomical Association hosted Dr. Shane Larson for a talk on gravitational waves.

Emily Hromi has left her role as planetarium and theater manager, and GRPM welcomes Jack Daleske as her successor, formerly of the Dome Planetarium at the Peoria Riverfront Museum.

Abrams Planetarium in East Lansing is
(Continues on next page)



GLPA. Science Day at the Evansville Museum on October 5 offered solar observing. Courtesy of Evansville Museum.

actively working on their new meteorite exhibit that will feature the most complete collection of Michigan meteorites. The staff recently acquired the Edmore meteorite's main mass. The exhibit will officially open in the fall of 2020. The staff recently welcomed Dr. Jessica Trucks, who will be joining Dr. Shannon Schmoll on the Big Astronomy project as a post-doctoral researcher.

Ohio. Retired planetarian Gene Zajac was recently in Sandusky preparing for an afternoon program at the public library. Wearing his Apollo anniversary shirt, he encountered a fellow shopper who exclaimed "Happy Anniversary!" As they talked, Gene learned that her father was a friend of Neil Armstrong and he was one of the four members of the "Mississippi Moonshiners" with Neil. She shared four stories about Neil during his high school days. Her stories are now part of Gene's programs.

Ms. Taylor Hines has been named the Sandusky City Schools new STEAM coach/planetarium facilitator, replacing Lois Wolf, who served as Sidney Frohman Planetarium director for 18 years and will continue part-time during the transition period.

Alex Mak reports that the Ritter Planetarium in Toledo is putting the finishing touches on an exciting new display at the Brooks Observatory.

Steven Wild reports that the Newhard Planetarium at the University of Findlay has upgraded its computer and sound systems, including the addition of a Starry Night podium. Recent outreach events have included planetarium use by art history classes, American Chemical Society events, a biology talk, and two Waste to Energy workshops.

Youngstown State University's Ward Beecher Planetarium has recently hosted live music events, a Harry Potter themed event, and its annual Halloween Night-lights show.

The staff of the Bowling Green State University Planetarium attempted a transit of Mercury open house on 11 November, but were clouded out and ran a webcast in the planetarium instead.

Wisconsin/Minnesota. At the time of writing, the Whitney and Elizabeth MacMillan Planetarium at the Bell Museum is planning to present, in partnership with Theatre Pro Rata, the play *Silent Sky* in February-March, which is about Henrietta Leavitt and a group of women "computers" pursuing astronomical research at the Harvard Observatory under the supervision of a male scientist.

The Manfred Olson Planetarium at UWM, Milwaukee in January started the year with an open house and a new produc-



GLPA. From top: Two scenes from the *Sphere* full-dome performance. Both courtesy of Société des arts technologiques.

Center: Kavli Lecture participants were taken to the construction site of the Large Synoptic Survey Telescope (LSST) in Chile. Bottom: Laura Trouille discusses the idea that a dust disc is responsible for strange light output from Boyajian's Star during a Kavli Lecture rehearsal. Both courtesy of Adler Planetarium.

tion called *Scale of the Universe*, and in March will have a special series *Under African Skies* that will showcase the different constellations visible from the different latitudes in Africa.

The L.E. Phillips Planetarium on the University of Wisconsin-Eau Claire campus resumed offering public shows in February this year.

The Sorel Planetarium in Milwaukee plans to debut in March a new show called *Constellations! Adventures Connecting Earth & Sky*.

The Horwitz-DeRemer Planetarium in Waukesha offered multiple programs during its annual Applefest last fall. To support the featured book *Lab Girl* during the local library's reading program, they had a guest speaker, a member of the ICE telescope project, speak and then showed the program *Chasing the Ghost Particle*. During their first Scout Night, 90 Brownies and Girl Scouts attended.

The Barlow Planetarium, Menasha is currently busy becoming part of the University of Wisconsin-Oshkosh. In July, the Milwaukee PBS production team from "Around the Corner with John McGivern" highlighted the city of Menasha and selected the Barlow Planetarium as one of the featured locations. Staff member Ellis "Ty" Westbrook has been promoted to planetarium educator and technician. As part of this new position, the planetarium will be installing a permanent Audiovisual Imagineering Skylase FX system.

Nordic Planetarium Association

Norway. On 6-8 September, planetarians from the Nordic and Baltic countries gathered at Vitenfabrikken, part of Jærmuseet, in Sandnes for the NPA conference. More than 40 participants enjoyed lectures, work-shops, planetarium shows, vendor demonstrations and fruitful discussions during the weekend. During the conference Kai Santavuori was elected new president for NPA.

Sweden. The planetarians at Royal Observatory Greenwich, England and Lund Obser-

(Continues on page 42)

Unexpected.

*Now available
à la carte*

Untethered.

Unbelievably easy.

Serious value for serious educators.

Portable and fixed systems up to 8k diameter.

DigitalisEducation.com

Digitarium® — The most popular
digital planetarium brand.



Digitalis®
EDUCATION SOLUTIONS, INC.



NPA. Participants of the NPA conference I Sandnes, Norway. Courtesy of Anna S. Arnadottir.

vatory have gotten together and decided to start a server where they can give out some of their fulldome productions, for free! If you are interested in free fulldome productions, then you can take a look at the project here for more information, previews, and download links: www.astro.lu.se/Outreach/PlanetariumResources/. If you have questions about the project or want to get involved and share your own productions on the server, please contact either Ed Bloomer, ebloomer@rmg.co.uk, or Anna S. Arnadottir, anna@astro.lu.se.

Russian Planetariums Association

Kaluga-Yaroslavl. In November 2019, the second Planetarium Tour took place in Kaluga and Yaroslavl. For the first time such an event was held in 2017, and it was a great success. On 9-10 November the fulldome shows of the Tsiolkovsky State Museum of the History of Cosmonautics (Kaluga) were demonstrated at the Tereshkova Cultural and Educational Center (Yaroslavl). On 16-17 November, Kaluga residents watched the fulldome shows of the Yaroslavl planetarium. Before the event, a lottery was held in the Kaluga planetarium. The winner received a special astronomical prize, and also inaugurated the Planetarium Tour.



RPA. Poster for the 2019 Planetarium Tour. Courtesy of Vasily Malkov.

Moscow. The Moscow Planetarium celebrated its 90th anniversary on 5 November. Today it is a modernly-equipped center of natural science. Its 25-m dome is one of the largest in Europe.

The Moscow Plane-

tarium is in the top 10 of the most visited science, educational, and museum complexes in the city and was several times called the best excursion sight of the Russian capital. Each day 3,000 people come there to see the stars. The annual figure is around one million of visitors.

Each year new excursions and educational programs are being developed for children and adults, new exhibits arrive, lectures of prominent scientists are held, and the most advanced technologies are implemented.

Several hundred people, including scientists, cosmonauts, well-known artists, musicians, TV hosts and showmen, representatives of legislative and executive authorities, and colleagues from other Russian planetariums arrived on the day to congratulate the planetarium with its anniversary. Best wishes were received from different Russian and world cities.

The premiere of its own production, *Multi-colored Universe*, took place during the anniversary celebration.

Novosibirsk. On 2-6 December, the Astronomical Olympiad Ursa Minor took place in Novosibirsk City. There were school children of the age of 12-14 years as participants of this Olympiad, coming to Novosibirsk from 11 Russian cities.

One of the stages of the competition was held under the dome of the Grand Novosibirsk Planetarium. The junior participants named the constellations, searched for errors in the starry sky, and determined their location on the Earth's surface by observations of the star's movement on the dome. In order to prepare well for this stage team leaders needed to interact with the planetariums in their cities.

Another stage was creative: The children wrote charades, a hymn to the sun, and a fable about the moon. Students from Simferopol, Kazan, Tomsk, and Novosibirsk became the winners of the Astronomical Olympiad, and Russian cosmonaut Salizhan Sharipov, who made two flights on the Russian Soyuz and the American shuttle, gave awards to the winners.

Ursa Minor came to the Novosibirsk Planetarium for the second time, and was financially supported by the Russian Presidential Grant Fund.

(Continues on page 44)

Make sure nothing escapes your audience.



Background image: © NASA, ESA, M. Robberto (STScI/ESA) and the Hubble Space Telescope Orion Treasury Project Team

ZEISS VELVET LED

More Colors. More Sharpness. More Detail.

ZEISS VELVET LED excels not only by brilliant images of highest contrast and outstanding depth of detail, but also by tried and approved ZEISS quality – from development to manufacturing to installation and servicing. VELVET LED features long-life LED illumination yielding improved imaging quality and an extended color space – from pure white to absolute black. The projected image boasts excellent resolution of both bright and extremely dark parts. That is why a 6k dome picture projected with VELVET LED may well look crisper than many an 8k image produced by other projectors, ensuring that hardly any mystery of the universe will escape the attention of your audiences.



www.zeiss.com/planetariums

Nizhny Novgorod. Celebrating the 100th anniversary of the IAU, the G. Grechko Nizhny Novgorod Planetarium organized Einstein Schools for teachers and schoolchildren. Topics such as Black Holes in Our Galaxy and Einstein's Universe were prepared and offered to participating schools.

A bright event for the planetarium was the traditional FENIST, an annual festival of sciences, arts, and technologies organized by the Institute of Applied Physics of the Russian Academy of Sciences. It was held at various venues in the city of Nizhny Novgorod, but the Nizhny Novgorod Planetarium was the most impressive venue for this festival.

Many successful meetings took place with scientists working at the forefront of astrophysics. Well-known Russian cosmologist Oleg Verkhodanov delivered two lectures in the planetarium: "Are there inconsistencies in cosmology?" and "Is the Universe tailored for us?"

European/Mediterranean Planetarium Association

Greece. The New Digital Planetarium of the Eugenides Foundation in Athens has completed *The Story of Earth*, its latest full-dome production, which is scheduled to premiere on March 16. The show focuses on the formation and evolution of Earth, highlighting the geological processes that cause earthquakes and volcanic eruptions and explaining why Mars and Venus are today so hostile to life, as opposed to our planet.

It has to be noted that this is the first time the New Digital Planetarium incorporates in its shows full-dome video live action of an actor-presenter. The show is accompanied by a fully illustrated 60-page guidebook that expands on the main theme of the show, and by a much shorter and easier to read booklet aimed for the younger children. Both books are freely available to all in pdf form on the planetarium's website.

Croatia. Further north, on the occasion of Earth Science Week, the Rijeka Astronomical Centre presented on 18 October a new planetarium show highlighting how the face of our planet changes daily, in an effort to promote understanding and appreciation of the Earth sciences and their applications.

On 26 October, the digital planetarium, participating in the Russian and Croatian project *Under the Same Sky*, organised a special concert with the Croatian choir Čakulone. The choir sang Croatian and Russian traditional lullabies under the starry sky of the planetarium's dome.

During the same event, Russian film producer Arsen Gottlieb presented the audio-visual show *World Lullabies*, with lullabies from Ireland, Congo, Russia, and Tatarstan, while Sergey Kiselev, an award-winning Russian tenor, sang a Russian lullaby.

In November, the centre participated in the *Glowing Globe: Science-Fiction-Art 2019* program, organized by the Rijeka Academy of Applied Arts, which included an international exhibition, a symposium, full-dome screenings, and artists' talks. The program was devoted to new-media art, with an emphasis on virtual and augmented reality. The full-dome film programme included a selection of films by students and teachers of the University of Applied Arts in Vienna, presented by curator Martin Kusch.

Also in November, the planetarium scheduled live shows for the Leonids meteor shower.



RPA. Participants of the Astronomical Olympiad in Novosibirsk. Courtesy of Sergey Maslikov.

During November and December, the Rijeka Astronomical Centre and the Rijeka Natural History Museum collaborated on the program *DINOdetective*, in which children were tasked to solve a riddle, based on some initial clues and with help from the *Mirage3D Dinosaurs at Dusk* planetarium show. During the same months, the astronomical centre introduced a planetarium show on asteroids and comets and after the show children and parents had the opportunity to visit the museum in order to find more about the age of dinosaurs.

Italian Association of Planetaria

The audio collection of dialogues about teaching instruments and images, managed by Serafino Zani Observatory and Planetarium, inspired the creation of the game *Rooms of Wonders* that involves audiences of different ages. The archive contains easy descriptions used for children and objects and images showed mainly with adults. The participants listen to an audio recording and try to connect each description to the instruments and the images that are exhibited in a room. To "win" the game, it is necessary to recognize the correct connection between the dialogue and the corresponding object or image.

Each time the content of the game is different. In fact, only a limited number of objects and images are exhibited, while all the complete collection is periodically updated on the web. The English text of the summary contains the description of instrument and images to help non-Italian readers to know which are the topics of the audio archive. The audio files (in Italian) are available at two Facebook pages.

At *Mostre e musei per tutti* (a Facebook page in Italian), each audio file is published together with a photo that isn't in direct connection with the description of the dialogue. Also, a short
(Continues on page 46)



EMPA. The Čakulone choir concert at Rijeka's digital planetarium. Courtesy of Rijeka Sport Ltd.

A full-page poster for 'COSMOS ODYSSEY'. The background is a deep blue night sky filled with stars and the Milky Way galaxy. In the upper corners, two satellite-like spacecraft are visible. In the lower foreground, there are silhouettes of astronomical observatories with large radio dishes on the left and a modern building with a curved facade on the right. A tall, thin, black silhouette of a person stands in the center foreground, looking up. Three bright orange laser beams originate from the top of the person's head and extend diagonally upwards towards the right, passing through the letters of the word 'ODYSSEY'.

COSMOS ODYSSEY

Our Quest to Discover the Universe

website : fulldome.kr
contact : threestar@metaspace.co.kr

METASPACE
Visualize your Imagination

Italian summary of each audio is provided without the name of the object or the image. On Not Only Stars (Facebook page in English), each audio file is published together with a photo that it is exactly the same (or similar) to that exhibited during the game and therefore is in direct connection with the description of the dialogue. Also, a short English summary of each dialogue gives a clear description of the content. The purpose is to help foreign audiences to know the content of each dialogue. The written text of the dialogue is available on demand (info@serafinozani.it) and can be translated into any language.

The complete list of all the dialogues (titles in Italian and in English) will be updated at page www.ips-planetarium.org/page/voicesit. The web page Voices From the Dome (at the IPS official web site) contains audio files in different languages. The Italian page contains the complete list of all the dialogues available and for each audio the corresponding URL page on Facebook.

The Rovigo Observatory and Planetarium, managed by the local amateur association, has been involved in an original public initiative during an art exhibition about Japan in Palazzo Roverella. An art historian, an actor and dancer, in the role of the two lovers, Hikoboshi e Orihime, and with the astronomical descriptions of the summer sky by an amateur astronomer, are all involved in an special event devoted to the Japanese tradition of Tanabata, the legend inspired by the constellations. Tanabata is a classical show in July in Japanese planetariums.

Some important dates in Italy: The Italian planetariums were involved in the 2020 International Day of Planetariums held on 8 March.

Please note that 26 March is the deadline of the PlanIt Prize for an original video production (first prize 500 euro, see www.planetari.org for more information).

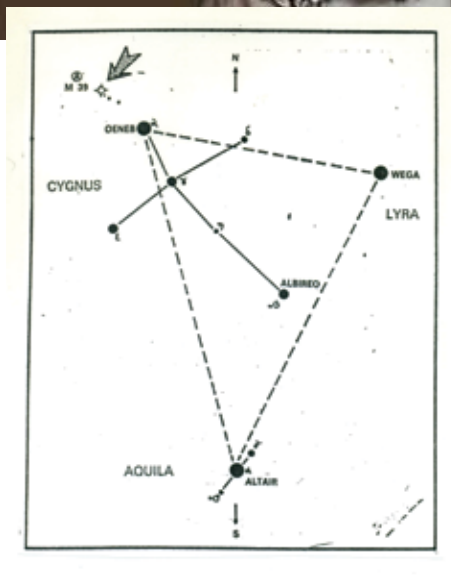
During the weekend of 24-26 April, the Italian Association of Planetaria will meet in Florence at the Planetarium of Fondazione della Scienza e Tecnica.

Since last September the StarLight, a Handy Planetarium Association has been collaborating with the Planetarium of Amelia, which the association has introduced to the IPS family. This planetarium lies among the beautiful hills of Umbria, within the park surrounding the Santissima Annunziata convent, where for decades a community of Franciscan friars has watched the stars and marveled at the beauty of creation.

The planetarium has a 6-m dome with an old opto-mechanical projector able to reproduce up to 3,500 stars with their apparent magnitude in a very dark sky. The planetarium is open for groups as well as schools, where visitors can enjoy the spectacular theatre of the sky and learn the secrets of the Universe. During the day time, visitors can also observe the Sun with a special Lunt solar telescope.

Once a month the Planetarium of Amelia is open for three hours during the night for individual or amateur astronomers who want to deepen their knowledge of a specific astrophysical topic (a different one every time) and of a different area of the sky. When sky conditions are good, telescopes can also be used for direct sky observation.

During the year, the Planetarium of Amelia is also open



IAP. Two of the images used in the game Rooms of Wonders. This famous celestial globe is related with the audio no. 31, and the celestial map of Nova Cygni 1975 is the topic of the recording no. 51 published on Facebook. Courtesy Loris Ramponi.

for other interesting cultural activities (a special night with a dinner under the sky in September, concerts under the dome, etc.). The convent can also offer self-organized accommodation for groups of up to 50 people who want to spend more than one day in Amelia.

Why should there be a planetarium in a convent? Who is to say that faith and science are not in harmony? They are two wings that allow man to become more human. For more information contact Planetariodiamelia@gmail.com or see www.planetariodiamelia.weebly.com, Instagram and Facebook. ☆



IAP. The opto-mechanical projector of the Planetarium of Amelia (left) and the dome during a school visit. Courtesy of Andrea Frigo.

(Classdome, continued from page 35)

I then turn off the star trails and show them a photo with star trails in it. I make sure to explain how the photographer made the image. I have several photos ready for different directions, but the photo starts out located in the southern part of the dome, which they are facing. I ask them to point at the direction they think the photographer was facing to take the picture. While this isn't following an object across the sky like the other activities, it does make them pick an answer. We deal with a lot of "intellectual apathy" at their age. Many students won't even try to answer questions. They just want to wait for the answer to be given to them. They have to pick a direction and actually point at it because of some encouragement from me and a little positive peer pressure.

Once they are all pointing, I make the picture fly across the dome and stop in the direction that is the correct answer. And then the fun part: say "woo hoo" if you got it correct. High school kids love making noise, so that is an easy sell. Sometimes I leave the star trails on for the first trial of this activity and tell them that I am "leaving the answer key visible" for them. We do this with the star trails off for a few subsequent trails. After 5 or 6 of these quick exercises, most of the kids get it right.

I wrap up with a nice easy one to make sure that all of them get at least one correct. That last picture is of circular star trails in the northern sky. By the way, did you know that if you search "star trails photo" on Google that about 99% of the results are images facing north? I guess everyone just naturally loves circumpolar motion (especially with that British accent)!

Thanks for reading and I will look forward to sharing some more



Star trails photo by Dino Quinzani, www.flickr.com/photos/squinza/421045067/, CC Attribution-ShareAlike 2.0 Generic License

ideas with you all in the next edition of Under the Classdome. Are you a classdome teacher who would like to join the cadre? Please email me at mpercy@williamsvillek12.org. I'd love to grow the group, especially with some from outside the USA. ☆



We keep you running...



New AstroFX support plans are universal!



- Bronze-Silver-Gold Support plans



- Available for AstroFX systems and systems *by others*



- Fast remote diagnosis and troubleshooting via Internet



- Manufacturer certified and trained technicians



- Loaners and spares in stock for quick shipment (Gold Level)



- Direct manufacturer support for faster repair



- Immediate replacement for failed equipment (Gold Level)



- Maximum 2 hour response time (during operating hours)

- 24/7 online video tutorials for AstroFX systems

AstroFX ...often copied...never duplicated.

See us in action at bowentechnovation.com/video.



Bowen Technovation

designers of electronic media

info@bowentechnovation.com



Tom Callen
Vaxholm, Sweden
tcallen08@gmail.com

What goes up, must come down CanSat competition takes students to new heights

Rather than write about something from years past, I decided to switch things up and write about the near present.

In April, I had the unforgettable experience of serving as one of three judges for the 2019 Nordic CanSat Competition held at the Andøya Space Center (ASC) in Andenes, Norway. Located on Andøya island in the Vesterålen archipelago, it is at +69N and above the Arctic Circle.

If this name sounds familiar, ASC was where two rockets were launched minutes apart for NASA in early April as part of their AZURE (Auroral Zone Upwelling Rocket Experiment) mission, producing artificial auroras seen over northern Scandinavia.

Besides real displays of the aurora borealis (sun and weather obliging), Andenes is also known for its whale safaris that go out year-round.

If you've not heard of them, CanSats are scientific probes built by international high school students that could fit inside of a regular soda can. They use a programmable Arduino card to control their various sensors onboard after they have been sent aloft by sounding rocket, helium balloon, or drone.

During descent by either parachute or controllable/steerable paraglider, they can take—and transmit via radio to a hand-held Yagi directional antenna on the ground—data such as temperature, atmospheric pressure, air quality, UV radiation, GPS coordinates, humidity, and even live video, among other things.

Besides radio-received data recording on the team's laptop, there can also be an onboard SD card logger to ensure that there was useable data in case of radio problems in flight.

Each (mostly mixed girls and boys) student group from Finland (3 teams), Norway (4 teams) and Sweden (1 team) had to complete both a mandatory primary mission and a secondary one of their own design. The primary part consisted of using sensors in their CanSats to calculate the altitude and temperature at the height they were at when released to make their descent, which could be corroborated with data from the drone that lifted them.

The event, day by day

Monday, 22 April: My wife, Mariana Back (who had a space education-related meeting at ASC that week), and I flew the nearly 1,500km from Stockholm to Andenes via Oslo and Bodø—with the last leg via a medium-sized turboprop—in what felt like a relatively short amount of time. Instead of finding snow on the ground as we had anticipated, it was just chilly, windy, and rainy.

Even though it was before 17:00 by the time we got to our hotel in town, there wasn't one of its 2,600 inhabitants in sight. As low-lying clouds scurried along horizontally in the near distance, we could see Middle Earth-like craggy mountain peaks covered by snow in the background that were adjacent to one side of Andenes.

Tuesday, 23 April: The weather on this morning was no better than the day before when we and fellow judge Samuli Nymann from Aalto University in Helsinki, Finland, headed over to ASC just outside of Andenes. Our third judging colleague, Danish educator Bente Jensen, is a member of ASC's well-organized Norwegian Center for Space Related Education (a.k.a. NAROM) staff.

After a morning of presentations about ASC and lunch, it was time

to evaluate each team's CanSat one group at a time to see if they were flight ready for Wednesday. Prior to this, it was important to have reviewed again their Pre-Launch Reports to be sure that the components of the secondary mission part of their satellites matched their stated intentions.

It also included assigning them a frequency for their onboard radio transmitters, spaced around 433MHz, and also checking to make sure



Judges (from left) Bente Jensen, representative of Norway; Samuli Nymann, Finland; and Tom Callen, Sweden. All photos courtesy Jan Holmgård. Holmgård is a teacher at Sursik School in Pedersöre, Finland. He manages the EduGalaxen blog at edugalaxen.com, whose purpose is to "nourish curiosity."

that each was transmitting viable data—for now the primary mission's temperature and air pressure—to a laptop.

All but two of the eight CanSats had 3D printed cans, while others had 3D printed frames inside their can to mount their components. Several teams even designed their own printed circuit boards to integrate everything together.

Fortunately, only one team had a serious design problem when it was found that their deployable paraglider was physically too large to fit inside the parachute holder (about the same dimensions as a toilet paper tube) mounted horizontally on the bottom of the drone. This was imperative to their secondary mission, as they were going to have a GPS receiver inside the CanSat steer the craft by pulling on the two control lines of the paraglider, to a GPS coordinate target on the ground at the launch site.

Retreating to the lab where the students had prepared their satellites before the inspection, they cut a large section out of the center of the paraglider, super glued the two halves together and then came back for another crack at passing the flight-ready inspection, which they did.

I was part of the evening's activities following dinner, giving a 45-minute long PowerPoint talk about key steps that led up to the successful Apollo 11 landing on the moon in 1969. Out of the approximately 45 people in the room, there were only three of us who had seen the event via TV when it happened.

Wednesday, 24 April: Right after breakfast, everyone piled into

buses with all their CanSat gear and headed to Skarssteinsdalen, which is about 12km from Andenes. This is where the original Andøya Air Station was located, but is now an adjunct facility to ASC.

Besides a large number of service vehicles, there are some big garages, one of which was being used by the students as a staging area to do their final preparation before walking out, one team at a time, to the launch area where the drone was located.

A challenge to recover the satellites

This area was about the size of half a football field, but the actual landing zone was a large shrubby field at the base of a short embankment. Due to higher than usual unseasonal rains, large puddles were scattered about in the landing zone. To help facilitate CanSat recovery, an Arctic Cat vehicle with tank-like treads in place of the four wheels and operated by an ASC staffer could drive out into this swampy plot of land.

While Bente stayed behind with the main body of students, Samuli and I set-up about 100m away at the launch site to watch the interaction between each team's members as they prepared to fly, since their cohesion and mutual cooperation were one of the ranking factors in the evaluation process. Who handled and how were sudden problems resolved?

Prior to the official flight, there was a test drop via the drone from 120m to make sure that a team was receiving their primary and secondary mission data. The procedure was the same for each team:

1. show up at the launch prep table
2. switch on your CanSat and show that there is a viable signal received by the antenna and that it is putting out usable data to the laptop
3. walk out to the drone pilot so that he and another ASC staffer could attach it to the bottom of the drone and
4. launch, followed by a radio-controlled drop.

I will only cite one of the CanSats here, as it had such an impact on everyone who saw it. Flown up to 120m and released, it fell like a stone until the first parachute deployed, which did not seem to slow it down very much. Their secondary mission was to slow their CanSat down from 11m/sec to 4m/sec from 30m above the ground. Things were not looking good until—POP! the top of the CanSat sprang open due to a signal received from the Arduino card based on sensor input—and the speed dropped and it floated gracefully the last 30m to the ground.

Everyone who saw it was ecstatic that it worked, including Samuli, me, and the ASC staffers nearby, as it had looked like a crash-in-the-making. But, as Samuli put it, it could also have been a fluke or pure luck that it had opened when it did. Only time would tell.

Time for the real deal

Following lunch, it was time for the real test flights, which took place at heights between 400 to 430m and were different team to team.

To mention two other CanSats, one had a LIVE video camera in its top that pointed up at its own parachute while another LIVE video camera, with a 165° wide angle lens, pointed straight down. Unfortunately, the down-facing camera's radio failed on this flight, but its feed was captured by the SD card.

The CanSat with the para-



Participants in the Nordic CanSat Competition 2019 wave to the drone's camera.



Top: The judges evaluate a team's preparedness; below: the last fixed program point of the day was Tom Callen's lecture "10 Steps to Apollo 11."

glider steered by its GPS receiver became partly entangled in its shroud lines, yet still managed to steer itself to 100m of its target: way off from the goal, which was not realistic to begin with due to the built-in inaccuracy of civilian GPS. But they did get a result that they could map.

And what of the CanSat containing the second parachute with the delayed deployment? Flown to over 400m, it really dropped like a stone until the first chute opened. All watched in great anticipation and sure enough, about 30m above the ground the second chute opened just like the drop from 120m, thereby proving that it was not a fluke.

There was only one casualty for the day's flights: one of the CanSats came down in one of the large puddles, but it was recoverable. After

shaking the water out that had infiltrated the can due to ventilation holes (the sensors inside can get hot!), it still functioned and was putting out usable data.

One of the best things about launch day was how the various teams encouraged each other whether they were from the same country or not. This was, no doubt, because all knew how hard the task was and how much work had gone into this from when they started their team's CanSat designs during the autumn of 2018.

(Continues on next page)

Returning to ASC, the students spent the rest of the afternoon and after dinner starting to reduce their data from their CanSats and beginning to prepare their Power-Point presentations they were to make the following day showing their results. Since there were a lot of things from the day that had to be digested evaluation-wise, Bente, Samuli and I retreated to another part of the building where there was no risk of being overheard by any team members and started to look at the flight results and team performance outside of any data issues.

Thursday, 25 April: This was a pretty busy morning for the teams as they were finalizing their data reductions from their CanSat's sensors as well as their presentations, which were scheduled for after lunch. All of the teams would be watching each other's results in the large classroom where most of the group activities took place.

A borrowed car running on empty

While they were beaver away on this, Mariana, Samuli and I drove a borrowed car (thanks, Jøran!) to Bleik, a small coastal fishing village, ten kilometers away from Andenes. Containing one of the longest pristine beaches in Norway, this little settlement of about 460 people is believed to be named after the color of its sand: white. It is also so small that there is no gas station, the nearest one being in Andenes.

This almost led to a real problem for us as our loaner car was almost empty and, just after we got back to ASC, the local highway authorities closed the coast road to Bleik due to the risk of landslides caused by all the recent rains. We saw, in fact, a few large boulders that had already come down, trapped in landslide fencing on the brow of a ridge overlooking the road. If we had gotten on the wrong side of one of those slides, we would have had to drive back to Andenes the long way around Andøya island and would have run out of gas.

After we got back from Bleik, Samuli and I found a quiet room away from the students and started going through all of the team's Pre-Launch Reports one more time to make sure that any questions we might have about a particular secondary mission had either been resolved between us, or was going to be questioned during that team's report presentation in the afternoon.

Post-lunch, each team had 15 minutes to make their final presentations, with all of their members participating in talking about different aspects of their missions. As could be expected with such a diverse



Group photo

group, some were well done while others were, shall we say, disjointed. But, in spite of that, all of the teams were able to get usable data from their CanSats and report their results.

After each team was finished, we judges had time to pose questions, which usually ended up with Samuli querying about technical and engineering issues (since he actually works with building satellites at Aalto University), while Bente and I stuck to mostly practical and data-related ones.

Following the completion of all eight team reports, the real work began for us judges as we retreated to the NAROM offices in an isolated part of the main ASC building to tally up our results and determine who would be the three national winners as well as the overall Nordic one.

Freed from their more serious responsibilities, most of the students went swimming at the small beach behind the ASC buildings, which, from what I heard, was about 6°C in the water. After about an hour of deliberations we were done and had our four winners chosen.

Fortunately, there was only one real instance where it was tough to choose between two teams that were very close together from the same country.

Dinner that night was a group outing to a local pizza parlor and, not knowing what to expect, we were pleasantly surprised. The restaurant had a nice variety of flavors in their pizza buffet that was, in style, very much like Pizza Hut® pan pizza, but not as greasy. And, unlike pizzerias in Sweden that all have similar varieties no matter the location, these seemed somewhat original in their topping combinations. Someone joked about whether or not there might be whale on some of them (spoiler alert: whale is served in some regular restaurants in Norway), but it turned out not to be the case that night.

Finally, the big day: We announce the winners

Friday, 26 April: Today was the big day: the awards ceremony where the teams got to find out if all their hard work the past six or more months had paid off. After some introductory words from Bente about how hard everyone had worked and what a good job they did, the Finnish, Norwegian and Swedish national prizes were given out by we three judges, with the overall Nordic winner being announced by Jøran Grande. Each of the national winners were now eligible to participate

after this Nordic event with the European Space Agency CanSat competition in Bologna, Italy, in June 2019 and they were given a generous stipend to help them out with their arrangements.

Everyone was supposed to leave at some point during this day, but, thanks to a pilot's strike by Scandinavian Airlines that started at 03:00 that morning while we were all safely tucked in our beds, some quick travel planning had to take place with the help of the ASC administrative staff. Some 40 students, their accompanying teachers and the other competition-related guests* needed to find a way home from northernmost Norway.

(Continues on page 58)



Oh—and you wanted the results?

The three national winners were Norway: Catmosphere; Finland: Team LarkCan; and Sweden: Limitless.

Both team LarkCan and Catmosphere went on to represent the Nordic region in the ESA European competition.

Winners from that competition, held in Bologna, Italy, were:

- Best Project: PerpetuumMobile from Elisabeth-Gymnasium Halle, Germany
- Highest Technical Achievement: IturramaSat 2019 from IES Iturrama, Spain
- Outstanding Science Mission: ArctowSky from Zespół Szkół Społecznych STO im. Pawła Jasienicy, Poland
- Most Professional Team: Catmosphere from Bergen Katedralskole, Norway
- Best Outreach: Charles 4th from SPŠE a VOŠ Pardubice, Czech Republic
- Honorary Prize: Project Beta from Stanislascollege Pijnacker, The Netherlands



Haritina Mogoşanu
Space Place at Carter Observatory
40 Salamanca Road
Kelburn, Wellington 6012
New Zealand
HaritinaM@experiencewellington.org.nz

A tough question with a miraculous answer

A kid came to me a few nights ago while stargazing and asked: “Excuse me, is it true that when people die they turn into stars?” It caught me by surprise, not because I don’t know the answer to it (“No, they don’t”), but because I felt that saying no to such a gorgeous question would be on the same level with declaring out loud that Santa Claus does not exist.

During the years, I’ve had lots of tough questions from kids, but that was by far the toughest. What if maybe someone he loved died (I could only think of my own grandmother) and his parents told him she turned into a star? For one moment I felt totally in the dark. Luckily, I made an amazing recovery—or at least I’d like to think I did.

I told him that as far as I know, it’s actually the other way around.

“When stars die, some of them turn into people,” I said to him. “We are truly made of stardust.” He was very happy about it and excited to learn the new information so he kept asking how does that happen. It ended well, he was hooked, and wanted to know more. Mission accomplished and the complicated question avoided.

The importance of iodine

Shortly after this conversation, I had to do an astrobiology talk about the big picture of life in the universe and everything, and “why should we bother.” As I was writing it, I looked to see which chemical elements are made in stars like ours and which ones were made in other events, such as neutron stars mergers. That was to debate the point that in order for us to exist, extraordinary things had to happen and that we are very lucky to be alive.

I discovered that iodine, which has the atomic number 56 and is classified as an essential trace element, is mostly made in neutron stars mergers. Iodine is part of the thyroid hormones that affect almost every physiological process in the body, including growth and development, metabolism, body temperature, and heart rate.

Neutron star mergers don’t happen very often; they only occur in a galaxy approximately every 100 years. You don’t just have one ball of neutrons crushed together so tightly that we don’t even really understand what it means (which is weird in itself), but two! The encounter of two neutron stars is in itself weird, as they would have formed from two really big stars that went supernova.

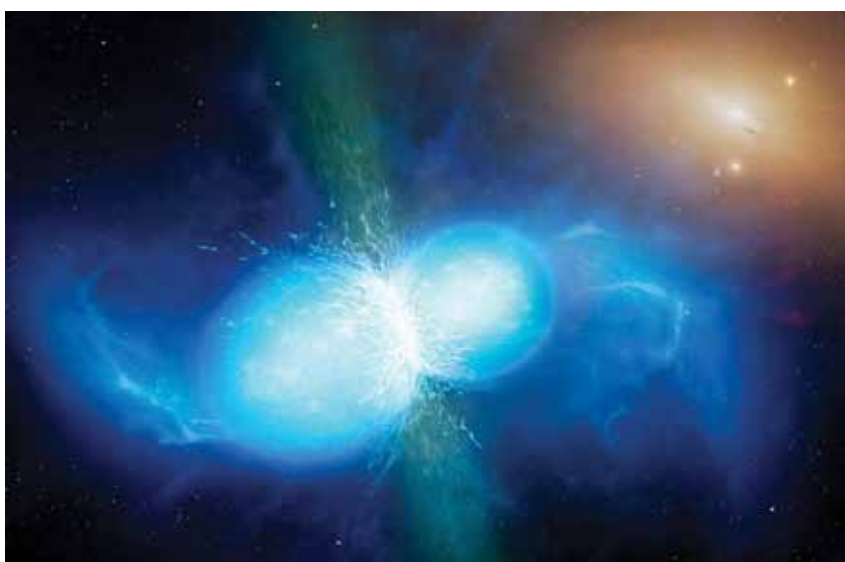
What’s amazing about iodine is that two of the most absolutely bizarre objects, these weird balls of degenerate matter, have to collide in order to make it. It can be formed through other processes, but the majority of iodine comes from these neutron star mergers. Until recently, we knew that chemical elements with large atomic numbers were made in supernovae explosions, and now science is providing more detailed explanations to what is really going on. We are all on a steep learning curve and that is good.

Next to this, the fact that the very water we drink had its start in space somehow pales in comparison.

So I really love this about my job, that I get to communicate these

things, these phenomenal things, to people who most of the time go to work from 9 to 5 or to kids who just started their journey in life. And the best thing about it is that I have a planetarium where I could look at what is going on, this extraordinary simulation of the universe and everything, from where everyday I myself learn so much.

We are often told that astronauts come back from space with a cognitive shift in awareness, which happens while viewing the Earth



Artist impression of neutron stars colliding. University of Warwick/Mark Garlick/CC (creativecommons.org/licenses/by/4.0)

from outer space. While nothing will replace actually going to space and experiencing the overview effect, I believe that being immersed in a planetarium (and the subject matter) for years could come close to it. Being under the dome does certainly and constantly change my perception of things in a huge way. It has kept me sane through life’s happenings and helped me question what’s important. It helped me see Earth as a fragile beautiful blue dot.

Being a planetarian is the best job ever because we get to influence the hearts and minds of people by using pure science to explain this amazing universe, where we don’t actually need miracles because science is a miracle in itself. ☆

Haritina Mogoşanu is an astrobiologist. Director of the New Zealand Astrobiology Network, director of Milky-Way Kiwi, and senior science communicator at Museums Wellington, she is actively involved in creating networks that engage space scientists with communities through hands-on programmes. Haritina came to New Zealand from Romania for the night sky and has been working at Space Place-Carter Observatory since 2005, presenting and promoting space sciences to thousands of young New Zealanders.



Karrie Berglund
Digitalis Education Solutions, Inc.
Bremerton, Washington 98337 USA
karrie@digitaliseducation.com

New year, new energy

This is my first column of 2020, and I must admit that I am glad to see the end of 2019. I had too many things to do and nowhere near enough time to do them. In the words of my favorite musician, Elvis Costello, “I [felt] like a juggler running out of hands.” I suspect many of you can relate.

The hectic past year made me think about motivation. What inspires people to keep giving their best efforts at work, home, wherever? In terms of this column, what inspires people to keep improving their live, interactive planetarium programs?

What inspires you to be the best?

I turned to the LIPS community for input. The question I asked was “Who (or even what) inspires you to be the best planetarian you can be and why?” Here are some of the responses I received:

From Karen Klamczynski, currently with E&S, formerly at the Barlow Planetarium, University of Wisconsin-Oshkosh:

When I was in a director position and in the dome doing shows (for any audience, any age), my reward was crowd engagement and feedback. Collective laughs, “ooohs” and “ahhhs”, and the best of all, the lightbulb moments—when you heard someone “get” something for the first time. I am moved by the memory of those experiences even now, a dozen years after moving from the dome to a position where I support others in the dome.

Nowadays, I help other planetarians create the sequences and shows that will elicit those reactions. I find that every class I teach, or planetarian I help one-on-one, is unique and often spawns new ideas—what would this look like on the dome? Can we create that effect? How can we demonstrate this concept? Can we look at this from another perspective? I am driven to follow up on these ideas and share them with a community of users. It’s incredibly rewarding to know some of my work is being used around the world to teach and inspire others.

Karen’s comments about her work being used around the world are also à propos for skills and activities learned at conferences. If you have a technique for demonstrating or explaining a difficult concept, share it. Your efforts will have a greater reach than you may realize, since the people you taught may then share it with other presenters. Like Karen, I find the idea of a broad reach to be inspiring and rewarding.

From Geoff Holt of the Madison Metropolitan School District planetarium:

The kids I interact with at the planetarium inspire me. I had a group of 3rd graders in the planetarium today before lunch, and we were “Hunting for Rocks in the Solar System.” They came prepared with a great background in rock formation and evolution, and as we went around the solar system, they came up with the best theories to explain what we were finding, and had some of the most insightful questions I’ve heard in a long time. It was so much fun. That inspires me.

Enabling students to share theories and questions is one of the strongest reasons for a live, interactive planetarium program. Every show is a unique experience, which helps prevent stagnation for the presenter, and students engage more with the material if the presenter fully integrates questions and student comments and theories. I think that

in order to be a successful presenter of live and interactive programs, you have to be comfortable not knowing exactly what will come next. When you reach that comfort level, the surprises are energizing rather than disquieting.

From Elizabeth Bracey of the Franklin Park Arts Center mobile planetarium, Purcellville, Virginia:

I have been thinking a lot about how much the planetarium has inspired me over the past two years. What I love about it is simply that it challenges me to keep learning. I am 53 and have been working in public service for 23 years. At this point in my career, I should be thinking about “fading out” to retirement. But honestly, learning about the planetarium and running shows has been a wonderful new experience that has energized me and challenged me in a completely new area.

Since astronomy is not my field of profession or my educational background, I have to learn about the subject each time I am presenting a show,



Many LIPS sessions are held in the round, facilitating conversation among the entire group. This photo is from the very first LIPS, August 2011. Photo by Rob Spearman

so at least it seems like I know what I am talking about. And the enthusiasm I feel about sharing the new things I have learned, seems to inspire others as well. It’s such a great feeling to be able to inspire learning in others. THAT is what keeps me enthusiastic about this very cool new adventure I am on!

One of the unifying characteristics of the LIPS community is that we love to learn new things, and we love to share those things. This is why a truly LIPS-style session features so much discussion time; we love to consider possibilities, and it’s exciting when we have a new idea or activity to share with our audiences. Just reading Elizabeth’s comments gives me a sense of her excitement; I have no doubt that her enthusiasm is contagious for her audiences.

From Clint Hatchett, former planetarian:

Simply one thing: The excitement people, especially kids, have for it all. I really miss experiencing that on a nearly daily basis.

I miss the excited responses of children myself, though I do sometimes have children in my sales demonstrations. Those demonstrations are typically my best, since I love the energy I receive from the kids. Hopefully Clint will be able to get back in the dome soon in some way; that energy is good for the soul.

LIPS energy keeps me going

As I noted at the beginning, 2019 was a tough year for me. So what kept me going? I can sum it up in one word (well, one acronym): LIPS. The LIPS community is the most generous, supportive, and welcoming group I've ever been lucky enough to be part of. While we have some shared experiences and qualities—for example, all of the comments from other LIPS presenters are also true for me—there are also enough differences in the way we approach tasks and questions that we will never run out of things to discuss. Knowing that I have a supportive group and a creative sounding board is energizing, and that was a huge help when I started to feel overwhelmed or frustrated last year.

I also find that talking to people who know little to nothing about the world of planetariums can be inspiring. Much of my human contact these days takes place at conferences that are not astronomy focused, such as the American Alliance of Museums or the National School Boards Association conferences.

I love hearing peoples' stories about the first time they visited a planetarium or when a portable planetarium was set up in their elementary school gym. I once had a teacher tell me that she thought planetariums are so memorable because they engage both the head and the heart; that comment has stuck with me over the years.

Some people who visit our portable dome on the exhibit floor are experiencing a planetarium for the very first time, and it is so much fun to share the adventure with them. I love hearing people gasp at the things that have become humdrum for me, like watching the sun set in the planetarium sky, viewing constellations from different cultures, or rotating a volumetric model of the Milky Way.

One of the most fun conversations I have ever had in a dome was during a conference for education service agencies staff and board members. I was doing a demonstration for a rancher from Texas who was explaining how he factored in the phase of the moon to plan wild boar hunts. I draw on these types of memories when I'm performing the less fun aspects of my job, like year end accounting preparation or many human resources tasks.

We all know from experience that our audience members frequently hold deep-rooted astronomical misconceptions. While this can be frustrating (how many times are we going to hear that rumor about Mars being as big as the full moon?!), it is also an opportunity to help the attendee come to a different understanding. If I can do that effectively, then it gives me a huge energy boost.

I expressly saved this comment as a closing note. It's from Alan Gould, former director of the Holt Planetarium at the Lawrence Hall of Science in Berkeley, California:

Even though I'm retired, I can't resist keeping ties with the community of planetarians who have become dear friends and who I find continually inspiring in the incredible variety of efforts and passions they're engaged in, as exhibited for example by their responses in this article (and others... and at conferences).

If you have ever met Alan, you know that he is a wonderful example of a lifelong learner and also one of the strongest proponents of live, interactive programs. In fact it is fair to say that LIPS in large part exists because of Alan Gould and another alumnus of the Lawrence Hall of Science, Dennis Schatz.

I worked for Dennis at Pacific Science Center, and Dennis is the single biggest reason for my passion for live, interactive planetarium programs. Both Alan and Dennis have been and continue to be inspirations in my planetarium work.

Dennis's name may be familiar to you since he is currently the president of the National Science Teaching Association, is a past president



Left: My former mentor Dennis Schatz, an inspiration to me from my days at Pacific Science Center. Right: Alan Gould and Kaoru Kimura (current IPS president-elect) having a conversation at LIPS 2011, the first ever LIPS. Photo by Ian McLennan.

and former board member of the Astronomical Society of the Pacific, and has published many science books for children. There is also an asteroid named after him.

In my opinion, the best presenters of live, interactive programs are those who manage to form a sense of community during a program. This is especially difficult in public shows, where most audience members do not know each other and can be of vastly different ages and experiences. However, I have seen presenters forge a sense of community from such an audience, and when it happens, it is magical.

You can get involved

If you would like to join the LIPS community, there are two main ways to do so:

- Send me an email requesting an invitation to the LIPS Google group.
- Visit the LIPS Facebook group page, and send a request to join. Search for "Live Interactive Planetarium Symposium."

There are two rapidly-approaching opportunities for in-person LIPS experiences:

- Sunday, June 21: I am organizing a Mini LIPS to be held at Telus World of Science Edmonton, the IPS 2020 host. This will be the first time—but not the last time—that a Mini LIPS has been held in conjunction with an IPS conference. You can register for the Mini LIPS when you register for the main IPS conference: www.ips-planetarium.org/page/ips2020
- LIPS 2020 will be hosted by the Fiske Planetarium on the beautiful University of Colorado Boulder campus. It will run from Tuesday through Thursday, July 14 - 16. By the time you read this column, LIPS 2020 registration for sponsors and non-sponsor attendees will be open. You can learn more and/or register at LIPSymposium.org

As usual I invite you to also send comments and questions directly to me: karrie@DigitalisEducation.com.

I hope to see you soon in person or online!

☆



Karrie Berglund is the director of education for Digitalis Education Solutions, Inc. and leads the Vision 2020 initiative on professional development. She is a former director of the Willard Smith Planetarium at Pacific Science Center in Seattle, Washington, USA.



Adam Thanz
Planetary Director
Bays Mountain Planetarium
853 Bays Mountain Park Road
Kingsport, TN 37660
thanz@kingsporttn.gov
www.baysmountain.com

Step-up DC-DC converter for Losmandy Gemini II

You may remember a short how-to article I wrote in this journal a little while ago about using a step-down DC converter to power a mirrorless camera for astrophotography from an external power source. It was very much a solution to a need.

This article is very similar, but now I explain a step-up power converter. It too, is a solution to a need, and this time, a more important one.

The problem: Using slewing speeds along with a GOTO function with a Losmandy telescope mount. The mount is sturdy and is designed well. The associated Gemini II GOTO controller and stepper motors are also made well, but for one fatal flaw. If your voltage is too low, and you use the default fastest slew rates to move the telescope to your desired celestial object, i.e. with a GOTO function and both motors at the same time, the stepper motors will stall. The result is that the telescope does not go to the desired object, but the Gemini II thinks it does.

The culprit is the 12-13VDC power source. The Losmandy mounts are advertised to run on 12VDC. They will, but only for slower motor speeds. What they really need is at least 15VDC. The Gemini II can handle up to 18VDC input, but 15VDC will work fine.

Unfortunately, you can only find this out after a frustrating night of the motors failing and then quite a bit of online research later to see what others have posted.

Step up is the solution

The solution is a step-up power converter. (You can do the same thing with an AC to DC converter that can output at 15VDC, but those are large, not really designed to be outside and more costly. I also didn't want a power cord to an outlet 5 meters away.) The converter I'm using provides 15VDC and 15 amps (15A). Be aware that the converter is capable of providing up to 15A, but only passes along the amperage that is needed if it is less. For my Losmandy G11 with Gemini II, I need at least 4-5A. Therefore, I have plenty of head room.

If you get a similar product, but less than 15A capacity, I would shoot for a minimum of 6-8A coverage to not push the unit to its max. You'll also notice in the picture of the converter that its ribbed body is a heat sink. If it were drawing 15A, the device would get quite warm.

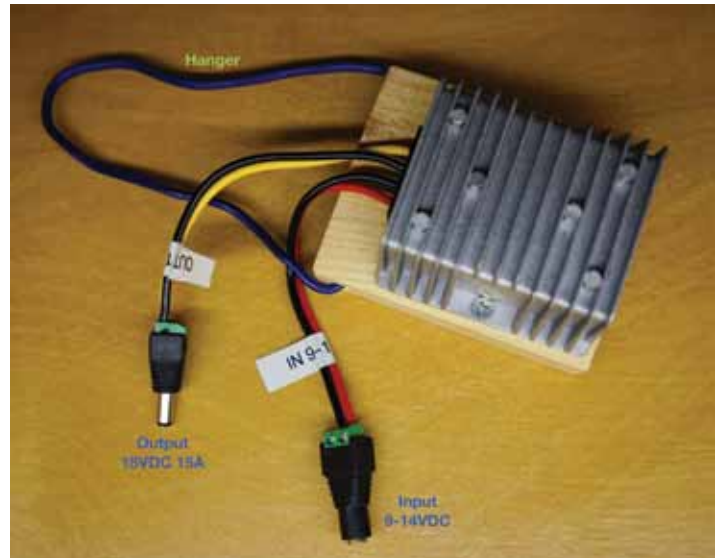
Another important spec to be aware of is the input voltage range. My step-up converter can accept 9-14VDC. This is very good. It means that, even though I'm using a 12VDC power source, the converter will still output 15VDC even if the voltage drops after some use or if it gets cold out. This means that it is regulated. The input can vary, but the output won't. Be sure to know that the voltage will drop while you use it.

The way everything connects is simple:

12VDC Battery Source (input) to Step-Up 15VDC Power Converter, output to Gemini II

Remember the step-down power converter for the camera? It plugs into the Gemini for power. But the converter has a range of acceptable input voltages of 5.5-32VDC and outputs exactly 8.2V. Be aware that the Gemini II will output the same voltage that is coming in through its second power port. The camera power converter being regulated is a great feature and can easily handle the input 15VDC.

The unit I purchased was from Amazon with the product description of: "KNACRO 15V 15A DC-DC Converter DC 9V 12V 9-14V to DC



The step-up power converter showing a simple in-out arrangement. Image by Adam Thanz

15V 15A 225W DC Boost Module Waterproof."

Yes, the product name is a mess. The key words to look for are:

- DC Boost (or Step Up)
- DC-DC Converter
- Regulated (or a range of input voltages)
- 12V (as your input)
- 15V (as your output)
- #A (You want at least 4A, but 6A or more is better.)
- Waterproof

The converter I purchased cost \$22.99USD. I attached it to a piece of scrap wood so it would not scrape the telescope. I drilled a hole across the full width and ran very stiff vinyl-coated wire through it to make a hanger. It hangs off a knob on the mount near the Gemini II unit, but remains "portable" as it isn't attached to anything.

The two connectors were leftovers from the previous converter project. Just make sure you connect the wires with the correct polarity.

I am happy to say that I can now slew from one object to another without a hitch. For the purists out there, I actually prefer manually moving the telescope to find objects and do so with a dedicated Telrad.

But there are times at public observings in developed areas when the sky is so gray you can't see many stars with just your eyes. Finding deep sky objects just becomes futile. Setting circles can be used in these situations, but unless you're really fast, it doesn't pay to be fumbling about when you have the public waiting on you.

Dark skies and keep on slewin'!

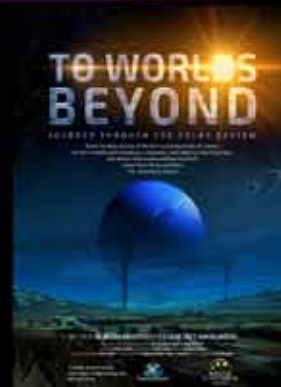


"How we do it" is an occasional column of tips and tricks submitted by planetarians. To submit your own tips, tricks, or methods of making your daily life easier, contact the editor at sharon.shanks@gmail.com.

AVI PRESENTS LASERS LIVE!



Joanne Young . 407-859-8166 . joanne@av-imagineering.com . www.av-imagineering.com





Susan Reynolds Button
Quarks to Clusters
8793 Horseshoe Lane
Chittenango, New York 13037 USA
+1 315-687-5371
sbuttonq2c@gmail.com
quarkstoclusters.wordpress.com

IAU100: Under One Sky Project welcomes Mobile Planetarium in the Pampa

Guilherme Frederico Marranghello reports that “The Unipampa planetarium, located in southern Brazil, has been awarded participation in the International Astronomical Union’s 100th Anniversary project “Under One Sky.” Unipampa’s mobile planetarium toured 18 cities, where about 15,000 children attended planetarium sessions and 500 teachers attended a training course.”

You can follow the adventures of Planetário da Unipampa on Facebook at www.facebook.com/planetariodaunipampa/.

On the IAU’s website it states “The IAU100 celebrations consists of coordinated activities on national, regional and international levels. Activities are planned so that people of all ages and all backgrounds can gain an appreciation for the central role of astronomy for education, development, outreach and diplomacy. At the moment there are IAU100 activities registered in 131 countries/regions.” <https://www.iau-100.org/nodes>

Unique venues and projectors

Here are just a few unusual places where portable planetariums have been found. Do you have any pictures of a unique location where you have used your mobile dome? Please share them with me for my next column!

Hospitals and private homes

Minoru Yamada from Japan wrote to tell me about a business that she started in 2014. Her company designs and builds a projection system called Docodemo. Her idea was to bring dome content to a variety of venues through using her “Everywhere Dome Series” of set-ups where the projection system can be used for:

- Exhibits with a hemisphere display, a global display, or a balloon display;
- A room planetarium (images are displayed on the walls); and/or
- Full-dome projection in a mobile planetarium.

She was inspired by two motives: she wanted to provide a broader array of ways that content creators could market their products, and she also wanted to make the content available to audiences who are disabled or ill and unable to visit a planetarium.

She told me about a group named Hoshi Tsumugi no Mura that is using her portable planetarium (Docodemo Full-DOME) for their activities. They are travelling to children who are in hospitals in Japan and are showing manual planetarium shows on a hemisphere in each child’s room.

Contact information: Minoru Yamada (Penny Arcade, Docodemo DOME) at qq2g75f9n@water.ocn.ne.jp; her homepage is pennyarcade.jimdo.com/

Later, I found more information in a story titled “Portable planetarium giving a boost to children in Japanese hospitals” that was recently published in the Japan Times.

It stated that a nonprofit organization, Hoshi Tsumugi no Mura, was established in 2016 by Mariko Takahashi, who was director of the Yamanashi Prefectural Science Center. Through this organization a portable planetarium is brought to hospitals in an effort to serve children who are ill and sometimes cannot go outside due to the risk of infection.

The article reports, “The organization has held 230 shows at about 160 locations across the country, entertaining over 12,000 hospitalized children.” The article explained that homebound patients can rent a projector and enjoy, through an internet connection, a presenter’s narration. www.japantimes.co.jp/news/2019/10/06/national/science-health/portable-planetarium-giving-boost-children-japanese-hospitals/#.XidiGshKjIU

Libraries

I discovered this report from the Central New York Library Resources Council: “Starlab Planetarium Adventures roving planetarium oper-



Magic walls-museums

In Italy, Loris Ramponi has taken a STARLAB planetarium projector to an art museum. With various cylinders used to project images on the wall next to the paintings, it can be demonstrated to visitors that classical Greek constellations and other astronomical references can be found in the paintings. Contact Loris Ramponi, email: megrez58@gmail.com

ated by STEM educator Chris Grubb presented programs at seven Syracuse libraries July 8 & 9, 2019. The programs complemented the New York State Summer Reading Program Theme, ‘Universe of Stories.’ Youth ages 6-16 were brought inside the planetarium where the night sky was projected on the ceiling and walls of an inflated dome. Chris Grubb’s talk included a demonstration of the earth’s orbit showing the zodiac constellations described as a circle of animals and a calendar of ancient times. Chris told ‘star stories’ related to the constellations and encouraged children to think about and create their own star stories.” <https://clrc.org/new-initiatives-grant-report-carol-johnson/>



BIG SKY

Think big, dream big!

IPS 2020 CONFERENCE

Edmonton, Alberta, Canada

June 18 to 25, 2020

REGISTER TODAY AT

IPS2020.twose.ca

THINK BIG!

Become a Sponsor Today

CONTACT:

Daryl Zelinski

1.780.452.9100 ext 2346

dzelinski@twose.ca



Outdoor locations

(Caution: gusts of wind not only distort the projection but have also been known to cause injury to people in inflatable domes that are situated outdoors. Take extra precautions if you wish to try this; having some kind of cover is preferable.)

Left: Roving Star Planetarium: Long ago, a manufacturer called R.S. Automation Industrie

produced this planetarium that was built on a trailer! Sadly, to my knowledge it is no longer produced. Center: Hiroshi Futami, from Japan, recently posted this picture on Facebook of his planetarium at his neighborhood preschool. He reported that his little visitors loved it. Courtesy Hiroshi Futami. Right: There's a giant planetarium in that teepee! Photo by Lars Broman.

IPS 2020 Edmonton Conference

There will be a significant presence of portable planetarium directors in Edmonton for the conference this year. In an effort to address specific concerns and questions from those who want to begin a portable planetarium program or business, there will be a one-hour session called "Outreach with a Portable Planetarium."

During this session panelists will share their experiences and advice about marketing, scheduling, presentation techniques for various grade levels, how to successfully run a program with an analog or a digital projector, program evaluation, unique presentation venues, and other topics you may request. I will serve as moderator and the five other panelists are:

- Marco Avalos Dittel from San José, Costa Rica
- Tilo Hohenschläger from Bornhagen, Germany
- John Meader from Fairfield, Maine, USA
- Guilherme Marranghello from Bagé, Rio Grande do Sul, Brazil and
- Dr. Ruth Grützbauch from Wien, Austria

I am sure this will be a very dynamic and informative session! ☆

Susan Button is a past president of IPS and has chaired the Portable Planetarium Committee since 1988. She is a retired portable planetarium director for the Onondaga Cortland Madison BOCES in Syracuse, New York, USA.

(Dome Under, continued from page 50)

Following lunch, Jøran took whatever teams and teachers that remained plus Mariana and I on a walking "cook's tour" of Andøya Space Center, which included the launching facilities where NASA's two AZURE project rockets took off from. Chunks of a blasted styrofoam box that originally surrounded the exhaust nozzle at the base of one of these two rockets still littered the floor in the one gantry building we were inside of.

Future ASC plans call for beefing up their payload launch capability—currently seven tons—up to 20 at a new spaceport facility that's in the planning stages. New additions are also being added to the main ASC buildings area as well as an upgrade to their "Spaceship Aurora"

educational activity, which is very much like Challenger Centers for Space Education that are scattered across the United States.

It was a fun, busy and challenging week that I could easily do again another year. Compared to the kinds of high school projects we were doing when I was their age, these students were light years beyond us. It was also very encouraging to see that the girls were just as into the technical and programming side of the competition as the boys were. And, since seven of the eight teams had members the Nordic equivalent of sophomore and junior high school grade levels, I would not be too surprised if I didn't see some of the same students at a future Nordic CanSat Competition.

* Mariana and I ended up taking a 5-hour taxi bus ride with the Swedish team on two-lane country roads from Andenes to Narvik, Norway, late Friday afternoon, stayed overnight in Narvik, took a 7-hour train ride Saturday through snow-covered mountains down to Luleå, Sweden (just below the Arctic Circle), stayed overnight there and then caught an afternoon non-SAS flight from Luleå back to Stockholm on Sunday. The week-long SAS strike ended up affecting 380,000 passengers worldwide and 4,000 flights. ☆

Touch the Stars, 5th Edition
by Noreen Grice

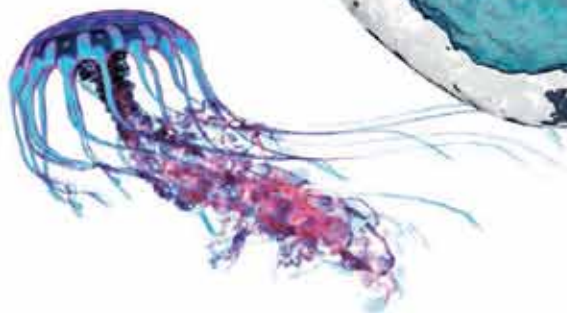
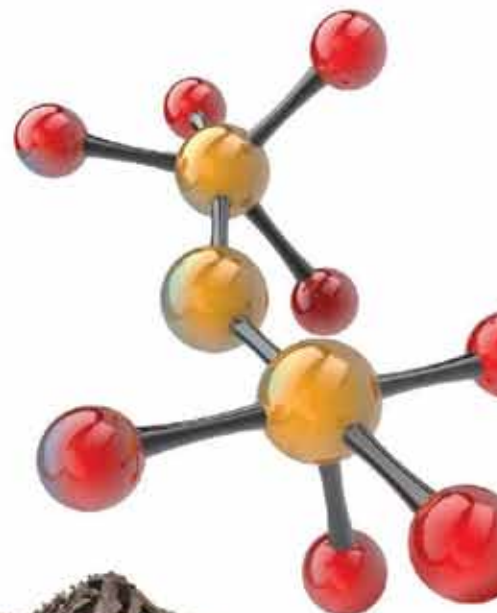
The astronomy book
with **print and braille**
and **touchable pictures**.

Now Available!

www.YouCanDoAstronomy.com

"Never limit yourself because of others' limited imagination; never limit others because of your own limited imagination."
— Mae Jemison

powerful educational **apps**



SciDome's growing library of educational applications includes the new **SciView™ Model Viewer**. Explore 3D models, tour environments, fly inside wire-frames, and create dynamic interactive animations. Learn more at www.spitzinc.com/scidome.

Scidome

TEACH bigger





April S. Whitt
Fernbank Science Center
156 Heaton Park Drive NE
Atlanta, Georgia 30307 USA
april.whitt@fernbank.edu

Sundials, space milestones, musing the moon and touching stars

Time of Our Lives: Sundials of the Adler Planetarium

Sara J. Schechner, Chicago: Adler Planetarium, 2019.

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island, U.S.

Do not let the title fool you: This is not just an inventory of a few artifacts within the Adler Planetarium sundial collection. This is one of the most meticulous volumes about sundials ever conceived.

When teaching kids about the sun, I often just tell them to put a broomstick in the ground and it will do a half-decent job of telling time. This book blows out of the water the concept of just placing sticks in the ground; instead, contained inside is one of the most beautiful collections of usable artwork ever bound together in one book.

In her acknowledgments, Author Schechner notes “This book has been long in the making.” In poring through it, it almost seems that producing this book should have consumed one person’s entire lifetime. It begins with the history of time, from the motions of the sun, moon and stars to the division of hours into 10 (or 12) separate parts and the various ways this was recorded for the common man. From there, we venture into the construction of dials to record the sun’s passage for religious and social purposes. Of course, then comes the question of how (and sometimes where) a person could “check” his time, resulting in actual handheld sundial models.

Probably the most incredible parts are the absolutely beautiful dials made through the ages. More than just practical pieces of artwork, these “machines” often served as centers of the community grounds or as showpieces in major citizens’ backyards, and some were even on the sides of buildings. It appears that each had to have its own individual design, for the variations seem to be endless.

We normally think of a sundial as just a flat object with a stick (gnomon) jutting up, but sundials can be folded with string as the indicator, or they can incorporate a compass dial; or they can be ornate, like the portable Butterfields.¹ They can be made as an armillary sphere, or even multi-faced, shaped very much like the original Spitz dodecahedron.² If your pleasure is in sound, there were sundials made that fired cannon at the noon hour.

All these sundials through the ages were exquisite in design, often crafted in silver or gilt brass for those with rich taste, or, for the low-end pocketbook, paper glued to a wood backing. But, either way, they were both a decorative and practical way to determine time.

This book is not only an unbelievable trip through—and with—time, but also one of the most beautiful collections of useful machinery through the ages ever put together. Each form of sundial is painstakingly detailed, complete with a photograph, and meticulously described

as to its manner of use. I, personally, had never dreamed the “simple” sundial could have such a past, plus be designed so many ways and so beautifully. *Time of Our Lives* should be read, not only by the science-minded, but those with a passion for beautiful, useful, artwork. It is well worth the “time” to do so.

The Space Book: From the Beginning to the End of Time; 250 Milestones in the History of Space and Astronomy

Revised and Updated. Jim Bell, Sterling Press, 2019.

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

Most of us use the internet these days to look up information. Hand-held devices bring encyclopedias of facts and data into our hands, proving Sir Arthur Clarke’s adage that “sufficiently advanced technology is indistinguishable from magic.” Yet every once in a while, a book—a physical wood-pulp-and-ink book—comes along that is every bit as wonderful, and doesn’t require batteries.

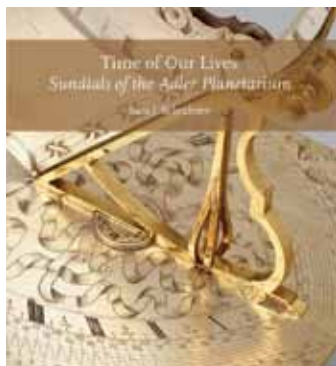
Jim Bell’s *The Space Book* is one of those. Full of facts and tidbits, it’s arranged chronologically, with large color images facing the text.

He starts with the Big Bang, c. 13.7 Billion BCE, works through ancient astronomies, geocentric and heliocentric solar system models, discoveries of planets and moons, the stories of men and women who studied and measured the sky, some Earth-based catastrophes, and the expanding exploration of our solar system by satellites, landers and rovers.

Some future is here too: Apophis’ near miss in 2029, human exploration of Mars (2035?), our galaxy’s collision with Andromeda (3-5 billion years from now), and the sun’s death (5 to 7 billion years from now).

And if you want more information, detailed end-notes list magazine articles and books, web sites and online applets.

Read it cover to cover, or dip into it anywhere. This book is an excellent resource for answering questions or just browsing and learning something new.



¹ en.wikipedia.org/wiki/Butterfield_dial
² en.wikipedia.org/wiki/Armand_Spitz

April Whitt is an astronomy instructor at Fernbank Science Center in Atlanta, Georgia, USA. She shares that she is so old that she has flown on both the Kuiper Airborne Observatory (KAO) in 1995 and the Stratospheric Observatory for Infrared Astronomy (SOFIA) in 2015.

Apollo's Muse: The Moon in the Age of Photography

Mia Fineman and Beth Saunders, Yale University Press and The Metropolitan Museum of Art, 2019.

Reviewed by Francine Jackson.

The Metropolitan Museum of Art's salute to the Apollo 11 program has ended its months-long exhibition. Titled "Apollo's Muse," the exhibit used several rooms to spotlight the moon in photography, art, and film. Included were images from the earliest daguerreotypes of the moon and early telescopic images to Neil Armstrong's incredible shots. Illustrations were present from over the centuries, from Ansel Adams, Etienne Trouvelot, William Pickering, and many others. There were also snippets from three major moon films: *A Trip to the Moon*, by Georges Melies from 1902 (the one with the rocket in the moon's eyeball), Fritz Lang's *Women in the Moon*, from 1929, and *Destination Moon*, the 1950 unique fore-runner to the Apollo mission.

Sadly the exhibit is now gone, but the next best thing to being there is the exhibition's catalogue, also titled *Apollo's Muse*, available for sale at the usual locations. Virtually every major part of the several-room exhibit, except for the movies, is included. In addition, the authors have given us a synopsis of the subject matter discussed within each chapter. In mapping, for instance, the first plate begins with Galileo, and continues until photography takes the place of the meticulous detail each artist needed to capture the essence of their observations, although the moon as an object of art, both serious and fanciful, is wonderfully depicted.

When photography takes over, much of the creativity is replaced by realism, including images taken both here on Earth and by both robots and astronauts traveling to our nearest celestial neighbor. The striking beauty in these cannot be compared with the pre-camera artwork, although both have their place in history.

And, yes, there is a very good introduction to the history of space flight, going back to the canine astronauts Laika, Bella, and Strelka, and the cosmonauts and astronauts who ventured off the Earth, showing us all that leaving our planet, although daunting, is viable. If you are too young to remember or not even born yet, there was a 1960's era television clip which showed Armstrong's first steps, with newscaster

Walter Cronkite and astronaut Wally Schirra doing the commentary for this legendary event.

Don't think that by missing the Metropolitan Museum of Art's actual exhibit you might have lost out on a great way to go back in time, from early lunar interpretations to the magnificence of Apollo 11, because this book will not let you down. Except for the actual movies (although there are stills from each one), *Apollo's Muse* has virtually the entire set of rooms in the Museum's exhibit space between its covers. As a history, and a collection of art, photography, and muses of our moon, this book is a must.

Touch the Stars

Fifth Edition

Noreen Grice, tactile illustrations by Irma Goldberg and Shirley Keller, National Braille Press, 2020.

Reviewed by April Whitt

When Ms. Grice's book *Touch The Stars* first came out years ago, it was a welcome addition to the materials we use in teaching blind and vision impaired audiences. This fifth edition is expanded in content, size, and excellence.

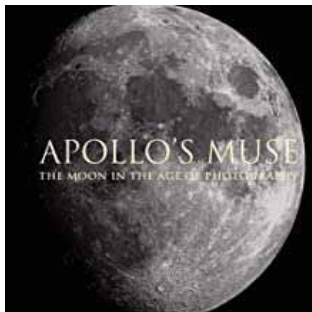
While Ursa Major and the other favorite constellations are included, there is so much more in this volume: planets in our solar system, comets, a meteor shower, deep sky objects,

an excellent introduction to astronomers from the early Chinese to Albert Einstein, and measuring the universe.

Tactile images are accompanied by print text, with accurate and clear descriptions. This book is a collaboration of renowned educators, and the sections were extensively tested by students at the Foundation for Blind Children.

The tactile comet notes that there are no clear boundaries in the parts of a real comet—nucleus, coma and tail—but that each fades gradually into the next. Measuring the universe uses the example of describing a distance as "a 60-minute drive," with the implication that a car traveling at 60 miles per hour taking 60 minutes to make the trip, and connecting that with the concept of light years.




The beautiful forward by blind astronomer Dr. Kent Cullers, retired SETI researcher (and the model for a similar character in the 1997 film *Contact*) is a lyrical start to this book. I highly recommend it for your audiences, blind or sighted, as an excellent resource. ☆



PARTYcles

#041 - Mar. '20

Alex Cherman

 <p>So let me get this straight...</p> <p>Being a proton does not make me a particle?</p> <p>It makes you BOTH a particle and a wave!</p> <p>Just like me, as an electron...</p>	 <p>We can alternate from one aspect to the other...</p> <p>...depending on the circumstances.</p> <p>WOW!</p> <p>So I can be whatever I want?!?</p> <p>In a matter of speaking... YES!</p>	 <p>I want to be a UNICORN!</p> <p>Or maybe a WYVERN!</p> <p>Errr...</p> <p>NO! Definitely a unicorn... Everybody loves unicorns!</p> <p>That is SOOOO how Quantum Mechanics does not work...</p>
---	--	--



Jeff Bowen
Bowen Technovation
7999 East 88th Street
Indianapolis, Indiana 46256 USA
+1 317-863-0525
jeffb@bowentechnovation.com

Making waves: The math behind music and sound (part 1 of 2)

A good number of you are in this profession after great deal of study of physics and math. Some of these studies would have included wave theory, so you may know a good bit of the math and physics I am addressing. Here, the real-world effects of those textbook subjects come to life and affect the way your dome audio system is designed and how it performs.

Wavelength and frequency: Real world meaning

The most important fundamental aspect of understanding a sound system is to understand the physical size of audio waves. Why? Because speaker components, microphones, and other audio components are designed to work with certain lengths of waves, which then determines various frequency responses.

Here is nice computer-based tone generator we can use: www.szynalski.com/tone-generator/



[szynalski.com/tone-generator/](http://www.szynalski.com/tone-generator/) (It is especially useful in that it shows a frequency and the corresponding note on a piano.)

Click on the number 440 and change it to 1000. (See figures 1 and 2.) Turn your computer audio way down and click play. The most basic element of audio is a 1000-cycle-per-second wave (1kHz where Hz is a Hertz or cycle). The length of a 1KHz wave is right at 13.56 inches (or 1.13 feet or 34.4cm).

Now change the number to 500. The pitch is lower. The wave is now 2x the length that it was for 1K, approximately 2 feet and approximately 70cm.

Now change the number to 2000. The pitch is higher. The wave is now 1/2x the length that it was for 1K, approximately 0.5 feet and approximately 17cm.

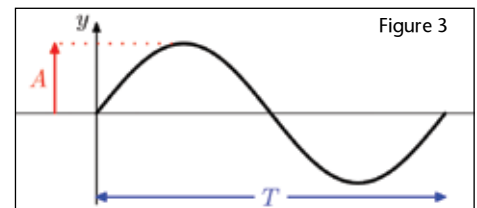
So, the wavelength is inversely proportional to the frequency, just as in all physics. (See also www.mcsquared.com/wavelength.htm.)

Jeff Bowen has worked worldwide as a planetarium and exhibit specialist since 1985 and has been named a Fellow of GLPA and IPS. He also serves on the IPS Immersive Audio Committee.

Figure 8 shows the frequency ranges of typical audio elements and musical instruments.

What does it mean?

The lengths of these waves are important in designing the theater acoustics and sound systems and in mixing show soundtracks for your facility. Think about it: the larger the room, the longer the soundwaves are that can “stand” in the room. The highest energy of the wave is at $\frac{1}{4}$ the length of the wave (Figure 3), so we can predict what wavelengths (frequencies) will be best (or worst) reproduced in the room and design the structure and treatments to solve these.



Controlling room acoustics

In general, three parameters influence the effectiveness of absorbing acoustic treatments:

- The type of material selected (porosity, density).
- The thickness of this material
- The airgap behind this material

Let's base this discussion on mineral fiber acoustic board, the most commonly-used material. Since the thickness of acoustic materials greatly determines the length of the sound wave being controlled, and thus the frequencies, carpet has almost no effect on the walls or the floor (other than foot noise). Figure 4 shows two applications of the same mineral fiber panels, but in 25mm (blue) and 100mm (green) thickness. As you can see here, the thicker material shows a small increase in absorptency above 2000Hz, but more importantly controls much lower frequencies. So those thin 1-inch and thinner treatments only affect higher frequencies and help only with a little high frequency chatter.

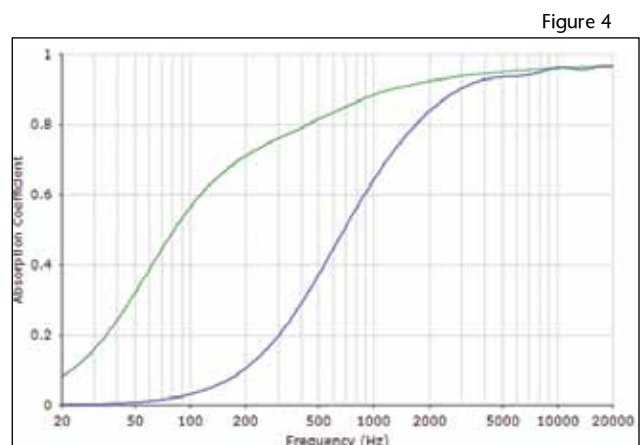
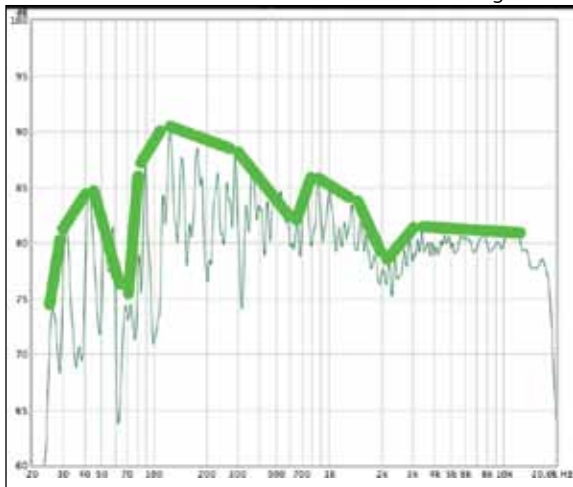


Figure 5



To control lower frequencies (a more common problem in larger rooms and domes), a thicker or more active treatment is needed. Figure 5 shows a response curve of a typical untreated large room. The area between 100 and 500 is a typical problem area and is unaffected by a 1-inch acoustic panel.

On another note: A common mistake is applying acoustic material directly to the wall surface. If the materials are applied on top of an airgap, their effectiveness greatly increases (Figure 6 is a 1-inch gap, Figure 7 is a 4-inch gap) and the airgap “simulates” the material being thicker, so the material is more effective on lower frequencies.

To maximize the air gap behind the materials without losing floor space, use the wall cavities as absorbers. The back side of the acoustic material does nearly as much work as does the front.

Part 2 will show you how we “tune” rooms for clean low frequency performance using the structure of the room and active treatments, not stuff stuck on walls.

Part 3 will discuss how the math behind sound effects your selection of audio speakers.

Feel free to contact me for templates or more information, all free to you as a valued member of IPS.

Note: The author will be available to discuss these subjects at the March 26 Day of Design seminars in Indianapolis, Indiana. There is no cost to attend. bowentechnovation.com/seminars2020/. ☆

Figure 6

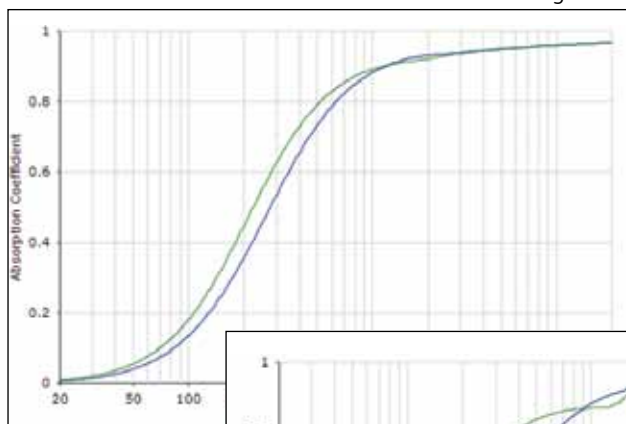


Figure 7

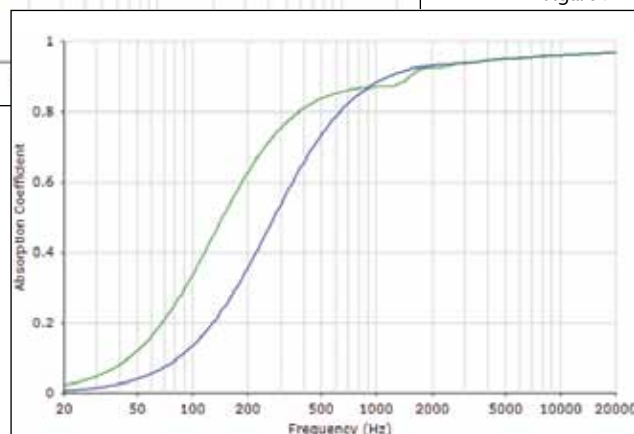
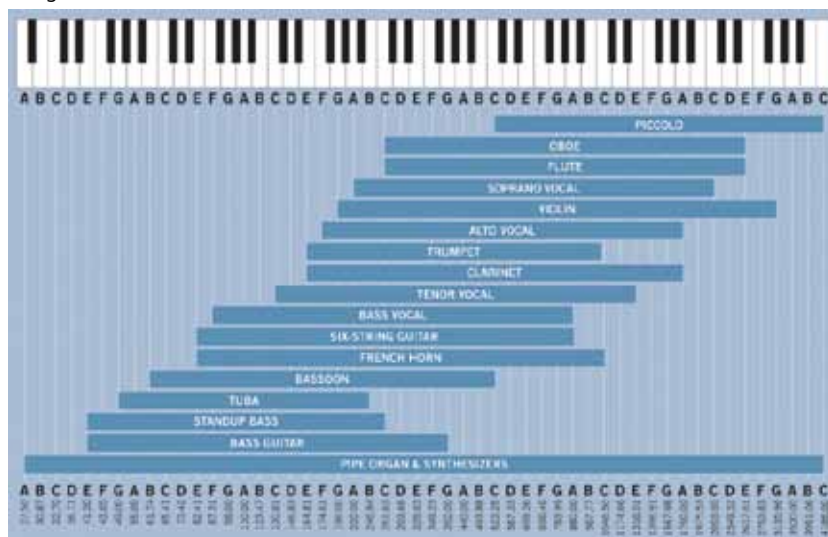


Figure 8



(5847) Wakiya = 1989 YB

Discovered 1989 December 18 by K. Endate and K. Watanabe at Kitami. Named in honor of Nanayo Wakiya (b. 1953), who joined the Japan Planetarium Laboratory in 1985 with the space artist Numazawa, after working for the Mito and Niigata planetaria. Among her many activities she writes articles for astronomical magazines and directs programs about space on television.

(5850) Masaharu = 1990 XM

Discovered 1990 December 8 by K. Endate and K. Watanabe at Kitami. Named in honor of Masaharu Suzuki (b. 1949), who is in charge of the Planetarium Programs Production Division at the Gotoh Optical Laboratory. He is also known for his production of 70-mm large-format films.

(5875) Kuga = 1989 XO

Discovered 1989 December 5 by K. Endate and K. Watanabe at Kitami. Named in honor of Naoto Kuga (b. 1964), who produces planetarium programs at the Gotoh Optical Laboratory.

(5975) Otakemayumi = 1992 SG

Discovered 1992 Sept. 21 by K. Endate and K. Watanabe at Kitami. Named in honor of Mayumi Otake (b. 1967), well known for her work as sound producer of planetarium programs.

(6884) Takeshisato = 9521 P-L

Discovered 1960 October 17 by C. J. van Houten and I. van Houten-Groeneveld on Palomar Schmidt plates taken by T. Gehrels. Named in honor of Takeshi (Ken) Sato, a devoted educator who was director of the planetarium at Hiroshima's Children's Museum. He is an amateur planetary observer who served as director of the Jupiter-Saturn Section of the Oriental Astronomical Association during 1960-1971. He initiated the ordinance to minimize light pollution in the town of Bisei, Okayama Prefecture. Enacted in 1989, this ordinance was the first of its kind in Japan.



Mark SubbaRao
Adler Planetarium
1300 South Lake Shore Drive
Chicago, Illinois 60091 USA
msubbarao@adlerplanetarium.org

The Data to Dome workshop at Colgate University

Guest authors

Joshua Finnell

Associate Professor, University Libraries
jfinnell@colgate.edu

Joe Eakin

Technical Director and Designer of the Ho
Tung Visualization Lab and Planetarium
jeakin@colgate.edu

Colgate University
Hamilton, New York USA



Finnell



Eakin

In 1952, architecture students at Cornell University in Ithaca, New York assembled a 21-foot spherical object on the roof of Rand Hall. Under the watchful eye of their professor, Buckminster Fuller, these students were erecting the prototype of his now famous Geoscope. Complete with electric light bulbs and connected to a computer, the Geoscope would be able to visualize all the world's data and create a globally-informed citizenry.

Fuller dreamed of a world in which the secret algorithms of society would be rendered with perfect clarity when writing about the Geoscope in his 1981 book *Critical Path*.¹ "Computers for each Geoscope will store all relevant inventories of world data arranged chronologically, in the order and spacing of discovery, as they have occurred throughout all known history (page 180)." Time-lapse images projected onto the Geoscope will display in a matter of minutes all sorts of global, long-term trends, everything from continental drift to human migration to use of transportation. "With the Geoscope humanity would be able to recognize formerly invisible patterns and thereby to forecast and plan in vastly greater magnitude than heretofore (page 183)."

Ever since Walther Bauersfeld engineered the the Zeiss-Planetar-

¹ St. Martin's Press, 1981.

ium in Jena, Germany in 1924, dome planetariums were constructed to realize the dream that Fuller had envisioned. Therefore, it seemed fitting that 67 years after Fuller erected his prototype on the campus of Cornell University—and exactly 67 miles up the road—that the Ho Tung Visualization Lab and Planetarium at Colgate University in Hamilton, New York, would host the first Data to Dome Workshop held in the United States in 2019.

Continuing the Data to Dome series

The first Data to Dome workshop was held in March of 2017 in Tokyo, Japan. Co-sponsored by the International Planetarium Society and the National Astronomical Observatory of Japan, the workshop brought together planetarium professionals, astronomers, and visualization experts to discuss and demonstrate the techniques of visualizing large, multi-disciplinary data in a planetarium setting.

A small follow up session was then held in July at the 2017 LIPS Symposium at Ball State University in Muncie, Indiana. A second Data to Dome workshop was hosted in 2018 at the the Iziko Planetarium and Digital Dome in Cape Town, South Africa. You can read a comprehensive report on the Tokyo workshop in June 2017 (vol 46, no 2) issue of *Planetarian* and access workshop materials and tutorials from both



Collaborating and brainstorming for creative problem solving at the Data to Dome conference at Colgate University. All photos by Joe Eakin unless otherwise noted.



workshops here: github.com/IPSScienceVisualization/Workshops.

This third iteration of the workshop, held in October 2019, shared similarly lofty goals as the first two in bringing together planetarium professionals, faculty from multiple disciplines, and visualization experts to collaborate and discuss multi-disciplinary data visualizations for the immersive setting of the planetarium.

Because the Ho Tung Visualization Laboratory is located on the campus of Colgate University, faculty and students from across the curriculum were able to engage with experts from around the globe about pedagogical use and curricular integration of data visualization in the planetarium. All participants engaged in hands-on workshops and demonstrations.

A total of 55 participants attended the two-day workshop, comprised of 18 international participants and 37 from the United States. The local conference planning committee consisted of Colgate's Heidi Ziemer, Wendy Falls, and Diane Janney. The Colgate faculty committee consisted of Santiago Juarez (Sociology and Anthropology), Mike Loranty (Geography), Joe Levy (Geology), and Howard Powell (Information Technology Services). The planetarium data workshop committee consisted of Dr. Lucia Marchetti and Prof. Tom Jarrett, both from the University of Cape Town, South Africa, and Mark SubbaRao, IPS president and Adler Planetarium, Chicago. The workshop chairs were Joshua Finnell (Colgate) and Joe Eakin (Ho Tung Visualization Lab).

This workshop was the culmination of a year-long collaboration between

- The Ho Tung Visualization Lab,
- The Colgate University Libraries,
- The South Africa departments of Science and Innovation and National Research Foundation,
- Iziko Planetarium, and
- The International Planetarium Society.

Additional support and sponsorship was provided by the Colgate University Lampert Institute for Civic and Global Affairs, Evans & Sutherland, Colgate University Information Technology Services, and the Colgate University Division of Natural Sciences and Mathematics. Conference presentations and materials can be accessed on the workshop website (www.datatodomecolgate.org/).

Creative problem solving and design thinking

The workshop opened with a talk on design thinking and a workshop on creative problem solving. Alli Torban, host of the Data Viz today podcast, was the keynote speaker and discussed a three-part conceptual model of a "data viz toolbox" in thinking about how to approach any data visualization project: orientation, consideration, and skills. This framework provided a useful heuristic for the day's workshops. In addition, Alli also interviewed attendees at the workshop for a special episode of her podcast, "How to Communicate the Value of Visualizing Data—Planetarians Show the Way" (dataviztoday.com/shownotes/49).

Following Alli's keynote was an interactive workshop titled "Data, Domes, and Design Thinking: A Workshop on Creative Problem Solving." This workshop was led by a cohort of Colgate University's Innovation Fellows, an innovation consultancy group focused on human-centered problem-solving both on and around the Colgate campus. Attendees were invited to create prototypes of their ideal planetarium and brainstorm solutions to common challenges working in their field.

Beyond the stars: Multidisciplinary use of the dome

An afternoon panel showcased the interdisciplinary use of the Ho Tung Visualization Lab by Colgate faculty across the curriculum. Santiago Juarez, assistant professor of anthropology, demonstrated how he combines satellite imagery provided by the Advanced Space-



Top: Using dome imagery session. Below: Group photo of attendees. Phot by Heidie Ziemer.

borne Thermal Emission and Reflection Radiometer (ASTER) and excavation data to visualize and analyze landscape features beyond the scope of traditional excavation. His work is specifically focused on Mayan architecture.

Exploring questions regarding the spatial and temporal dynamics of biosphere-atmosphere interactions in boreal and arctic ecosystem, Associate Professor of Geography Mike Loranty demonstrated how he combines arctic permafrost data with Google Earth to investigate how changing ecosystem processes influence climate. Similarly, Joe Levey, assistant professor of geology, uses a LiDAR camera to map the current topography of Antarctica and then overlays them with historical NASA scans at ground elevation to visualize melting permafrost.

Each presentation echoed Buckminster Fuller's dream of humanity being able to "recognize formerly invisible patterns" through big data visualization.

Spiders, drones, atmosphere, and Digitstar

During the morning session, attendees chose between four workshops, scheduled in parallel tracks to facilitate hands-on demonstrations. Ahmad Khazaei, director of information technology service engagement at Colgate, led participants through the applications of drone imagery: surveying sites, remote sensing, and 3D modeling. Conducted outside, this workshop humorously culminated in a hawk attacking the flying drone.

(Continues on next page)

Kevin Scott, product manager at Evans & Sutherland, demonstrated the myriad ways that Digitstar can support data processing and visualization. Fairuz Ishraque, a Colgate student, demonstrated how to find, clean, compress, and visualize National Oceanic and Atmospheric Administration data for use in the planetarium. And Ben Gorton, assistant at the Ho Tung Visualization Lab, gave a demonstration of the Artec Space Spider, a high-resolution 3D scanner originally developed to spec for the International Space Station.

Astrolabes, cosmology, OpenSpace, Dark Matter, VR

In the afternoon, all attendees attended five dome demonstrations covering a wide range of topics. Dayna Thompson, director of the Brown Planetarium at Ball State University (Muncie, Indiana) and Mark SubbaRao, director of the Space Visualization Laboratory at the Adler Planetarium, demonstrated how to use data by The Solenoidal Tracker at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory to visualize the moments after the Big Bang on the dome.

Nandivada Rathnasree, director of the Nehru Planetarium, demonstrated how to import images of historical astrolabes into planetarium software skyviews with fisheye stereographic projections to test the relative accuracy of the star markers depicted.

Carter Emmart, director of Astrovisualization at the American Museum of Natural History (New York), provided an overview of OpenSpace, the NASA-supported, open-source, freely-available software to visualize astronomical and planetary data seamlessly across all scales and operating systems.

Finally, Lucia Marchetti, SARChI NRF/SKA post-doctoral research fellow at the University of Cape Town and Thomas H. Jarrett, SARChI chair in Astrophysics and Space Science at the University of Cape Town, demonstrated how they are using Dark Matter planetarium software for data visualization of multi-disciplinary data sets. Lucia and Alexander Sivitilli, doctoral student in astronomy at the University of Cape Town, demonstrated a prototype of the Data Visualization Interactive Explorer (iDaVIE) virtual reality software on the dome.

Next steps

The two-day workshop culminated in an open forum and brainstorming session with all attendees about the future directions of Data to Dome Workshops. Discussion centered around resource-sharing platforms, educational resources, connections to other professional organizations, and incentivizing participation. Interest was expressed in establishing the <http://www.data2dome.org/> website as both an online community and a centralized repository of tutorials and educational materials. Building upon the tutorials and workshops ideas from the Tokyo workshop in 2017, the group suggested future workshops focus on dome master creation, plotting data with Python, and running workshops like a hackathon model.

In addition, a few attendees suggested creating a Data to Dome Massive Online Open Course (MOOC) as a foundational introduction and focus workshops on advanced, hands-on sessions.

Others recommended connecting with allied data organizations to spur interdisciplinary conversations between planetarians and researchers from a broad range of disciplines. For example, these could be creating a Data to Dome Interest Group within the Research Data Alliance (www.rd-alliance.org/) and creating topic-specific working groups, like Visualizing Climate Change. To spur interest in this initiative, attendees suggested developing an annual Data to Dome award, modeled after fulldome festival awards.

Overall, the two days of workshops, demonstrations, and conversations on the Colgate campus further underscored a small but energetic interest in exploring multi-disciplinary data visualization in a



Scenes from around the workshop.

planetarium setting. Many of the attendees had previously attended a workshop in Tokyo, South Africa, or the session at the 2017 LIPS Symposium at Ball State University. With sustained interest established across multiple years, the next step will be to formalize this group into a robust community of practice. ☆



Ron Walker
The Star Barn Planetarium
P.O. Box 161
Cave Creek, Arizona 85327-0161
thestarbarn@gmail.com

If the tune fits, write the lyrics

As you read this, the first (and probably last) "Amateur Home Planetarium Conference" will be happening in just a few days (if it happens at all) on March 24-26. Hopefully there will be some attendees, or I will be eating beer-boiled brats for a long time to come.

As has become the norm, I will force upon you another of the spectacular arias from the (rock) Opera "Beyond The Sixth Magnitude," this time in honor of the 100th anniversary of the planetarium projector. Copyright Gareron Music, used with permission.

This one is a bit different in that it is a bit darker than my usual fare. Actually I had forgotten about it until someone mentioned it and I really didn't even remember writing it.

I'm sure you will remember the melody from an old 1939 movie.¹ (It wasn't the other 1939 movie, *Gone With The Wind*, but I must admit that title holds some truth as well.) So, here it is, with sincere apologies to Zeiss. I really do love the Zeiss projectors.

Dong Dong the Zeiss is Dead

Ding-Dong, the Zeiss is dead,
The wicked old Zeiss is finally dead,
Ding-Dong, the wicked old Zeiss is dead.

Pristine stars it did produce,
But who needs them, we've got the juice,
With video we can now produce,
Cartoons across the dome.

So, do not fret, we won the bet,
Into the new millennium we tread,
As movies we project,
upon the darkened dome.

Now, don't be sad. It's not so bad,
The wicked old Zeiss hasn't had it bad.
But now it's gone, so say so long
The wicked old Zeiss is dead.

Ding-Dong, the Zeiss is dead,
The wicked old Zeiss, is finally dead,
Ding-Dong, the wicked old Zeiss is dead.
Its gone to where most classics go,
on to landfills high and low,
it's sad new kids will never know,
the glories it could show.

Some just stand and slowly rust,
until they just turn into dust,
People look but will never know,
that this great clock it was the show.

Some of us we try to save,
relics that are no longer made.
Scenes like this will make some cry,
we wonder why we even try.

Ding-Dong, the Zeiss is dead,
The wicked old Zeiss, is finally dead,
Ding-Dong, the wicked old Zeiss is dead.



The "removal" of a Zeiss VI. Photo source unknown and sought.

You might wonder what landscape of destruction could possibly send me in such a negative direction. It was a picture of the "removal" of a Zeiss VI, I believe from Boston. Not sure who took this picture,² but it is indeed depressing for those of us who love and appreciate fine old clockwork.

Anyway, on to more entertaining things.

Keith's captured quips, chapter ten

"When your not doing schools what is it like? Is it much like the other? I'll bet it isn't."

"I learned that the big dipper sometimes is conected to the little dipper but also sometimes not conected to the little dipper."

"I learned that Orion was a person not a cat." (I think this refers to the movie Men in Black.)

"I like your magnificent planetarium."

"I wish I could come back today but I live in Fallon maybe you can build some kind of planetarium here. Maybe a big one Maybe a small one who knows."

Ten years ago

March 2019: We start with a little buttering up of our editor. Sharon Shanks, in her column "In Front of the Console," gives us the line, "You cannot teach passion. You can only _____ passion in a student." Unlike tests when I was in school, we are even given the answer. Pick from the following: ignite, foster, arouse, awaken, excite, kindle, provoke, stimulate. Not only a fill-in-the-blank question but the answers as well, and all the words are correct. Unfortunately, it appears generating money and making a profit is becoming more important than educating students.

(Continues on next page)

¹ *The Wizard of Oz*, Metro-Goldwyn-Mayer.

² If you know the source of this photo, by all means let me know! I will give proper credit in the next issue.

Mike Shanahan, in "Making it Better," explains how to take a new show and make it better through audience feedback. What is interesting is that "stars and constellations" are the most important things to the various audiences. What they hated the most were crying/noisy children. What I found most interesting from this is that the length had to drop down to a half hour before visitors stopped complaining the show was too long.

I must interject that I have a hard time keeping a show down to an hour and have given up on a couple that run ninety minutes....but then the shortest entertainment movie is about ninety minutes and many go well past two hours. Perhaps the problem is that I like to hear myself talk, but that is an answer only the psychiatrists can provide.

For those of you who don't believe that planetariums are not turning into movie theaters, I offer you the title of Clark Planetarium's latest show, *Attack Of The Space Pirates*. They don't want the high seas. They want the universe.

Twenty-five years ago

March 1995: Articles about two of my favorite astronomy people lead this issue of *Planetarian*. Let's start with the man who made planetariums popular, Armand Spitz. Brent Abbatantuono calls him a "Seller of Stars" in his master's thesis on Mr. Spitz. This article represents the fourth chapter of the longer work and is more or less a history of Armand's life.

There is so much information here that it is worth looking back and reading the entire article. If the entire thesis is as detailed and interesting as this chapter, I think the IPS should find a way to publish it for the 100th anniversary of the planetarium. I will just grab a few quotes from Mr. Spitz to whet your appetite.

"I never expected to make any substantial contribution to astronomy or science, but what greater satisfaction can I have than to have one very famous astronomer tell me that he gained his first interest in

astronomy through viewing a Spitz planetarium when he was a small boy. I can only hope that in whatever celestial book-keeping there is I will be given indirect credit for helping along the knowledge of the heavens."

"I am not a mathematical astronomer. I don't get along with mathematical equations. I am not very much of a scientist. You can call me an interpreter of science if you want to."

"The fact remains that into a sea of relative placidity, I was privileged to drop the proverbial pebble and the ripples have been moving outward ever since."

The second is a man credited with making the phrase "billions and billions"³ popular. In an interview with Anne Kalosh, Carl Sagan tries to "bring science down to Earth." It is said that 94% of U.S. citizens are scientifically illiterate (I wonder what it is today). I'm as shocked by the fact that some 80% of humankind have never seen the Milky Way. Again, there is so much more information than can be printed here, but do go back and re-read these articles.

In "Planetotechnica," Richard McColman takes a look at light dimmers in "Dimmers Gone Haywire." We are talking about light dimmers that use a triac to control the voltage feed. The big problem is usually the neutral or ground side of a voltage source. Now mixed grounds are not new to the old optical/mechanical crowd, as slip rings are usually in short supply. Using a common ground or neutral line can cause numerous problems. The simple way is to have a separate neutral with each hot line and keep various sections of equipment together on their own phase. Or you can just be a cheapskate, like me, and use Variacs as dimmers. All problems solved.

Forty-five years ago

March 1975: Again we have a double issue (or perhaps I should say a double date for a single issue), again looking like it was typed on a IBM Selectric typewriter. Hard to believe this was 45 years ago, especially considering I was well into the work-a-day world for over half a decade. I well remember and think I still have one or two examples of this device. Without spellcheck, it is a wonder I communicated at all.

Since we are looking forward to the 100th anniversary of the projection planetarium, it is interesting to look at T. W. Hamilton's list of planetarium projectors built and available through the years. Quite a complete list; I had no idea there were so many manufacturers of these devices. What is also quite interesting is how few of each model were made.

This list was made in 1975, but already many of the designs were updated into newer models. A projector as prolific as the Spitz A3P still only produced 350 units, not a super seller by any means. No wonder these things cost what they cost.

Also penned by Mr. Hamilton is an interesting article, "Simulating Daily Motion For Solar System Objects." Before the digital computer revolution only one projector that I know of, the Spitz STP, could project a sky from most places in the solar system. I'm sure many of the later generation projectors can do so, but I've never researched that area.

By using the procession and other motor drives, the motion of the fixed stars can reproduce a fairly accurate rendering of views from other planets in our solar system. This is interesting and I can see the beginnings of a new show, "views from the other planets." Now I must find a way to add the small blue marble to the planetarium sky. ☆

3 Although Sagan never actually said "billions and billions," the words appear as the title of his 1997 book *Billions and Billions: Thoughts on Life and Death at the Brink of the Millennium*. (Random House) It was the last book written by Sagan before his death in 1996.

After 40 years as a commercial, industrial, and feature film maker, for Ron Walker controlling the universe in his "Star Barn Planetarium" was a natural step forward. He reports that surprisingly, viewers actually enjoy his shows, which unfortunately forces him to write new ones between naps.

An early start on the centennial, a fitting tribute to the Zeiss



In Austria, it is possible to design and produce personal postage stamps. There are a number of conditions imposed by the Austrian Post Office and stamps must be printed by the State Printing Works, but the result is a special stamp that can be used for official postage in Austria.

Andreas Scholl in Ellmau, Austria, took the initiative to produce a stamp to celebrate the centennial of the planetarium.

The drawing, made by his wife Manuela Scholl, shows the first planetarium projector in the world, the Zeiss Mark 1 from 1923. The dimensions of the stamp are 35x42 mm and the face value is 1 Euro.

"This stamp should also remind all planetarians from all over the world to contact your national postal agency on time to propose the issue of a special stamp in your country in 2023," Scholl said.

Although he did not undertake the project to make a profit, Scholl is willing to sell some of the stamps at 2.50 Euro each. Interested people may contact him directly at andreas.scholl@gmx.biz. ☆



THE EDGE

PLUTO AND BEYOND

NOW AVAILABLE

clarkplanetariumproductions.org

contact: msheehan@slco.org 385-468-1226





Ronald Maddison

Ronald Maddison January 1, 1935–December 29, 2019

Ronald Charles Maddison passed away peacefully at the Advent Hospital in Orlando, Florida, at the age of 84. Ron will be lovingly remembered by his wife Margaret, dear father to Christopher, Julia and stepson Mark.

Ron was born in Birmingham, England, where he taught astrophysics for 33 years. He moved to Florida in 1991 and was observatory director at the BCC Planetarium until 2006. He was a great lover of steam trains, spending many happy hours building models. ☆



Heather Couper

Heather Couper 2 June, 1949–19 February, 2020

Heather Anita Couper, CBE, FRAS was a British astronomer, broadcaster and science populariser. After studying astrophysics at University of Leicester and researching clusters of galaxies at Oxford University, Couper was appointed senior planetarium lecturer at Royal Observatory, Greenwich.

She subsequently hosted two major series on Channel 4 television, *The Planets* and *The Stars*, as well as making TV guest appearances. On radio, Couper presented the award-winning programme "Britain's Space Race" as well as the 30-part series *Cosmic Quest* for the BBC.

Couper served as president of the British Astronomical Association from 1984 to 1986, the first woman to hold the position, and was Astronomy Professor in perpetuity at Gresham College, London. She served on the Millennium Commission, for which she was appointed a CBE in 2007. Asteroid 3922 Heather is named in her honour. ☆



John Campbell Brown
Photograph by Mike Peel (www.mikepeel.net),
Wikipedia

John Campbell Brown 4 February, 1947–16 November, 2019

John Campbell Brown, OBE FRSE, was a Scottish astronomer who worked primarily in solar physics. He held the posts of Astronomer Royal for Scotland, the Regius Professor of Astronomy at the University of Glasgow, and honorary professorships at both the University of Edinburgh and the University of Aberdeen.

He was appointed the 10th Astronomer Royal for Scotland in February 1995. He was awarded the Gold Medal of the Royal Astronomical Society for his work on solar energetic particles and other contributions to astrophysical research and public outreach. Brown was appointed an Officer of the Order of the British Empire (OBE) in the 2016 Birthday Honours for services to the promotion of astronomy and science education.

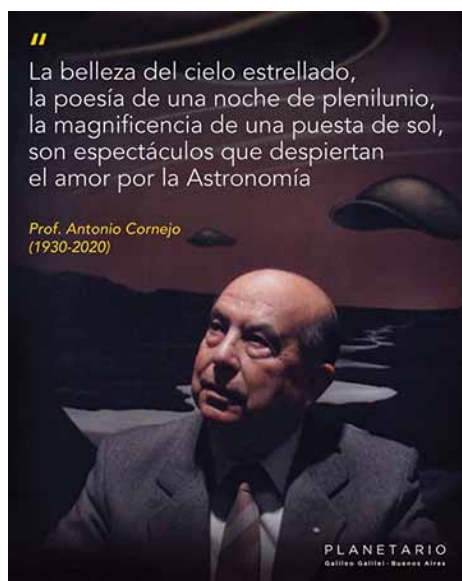
He also was Honorary President of BAP, British Association of Planetaria. ☆



Larry Krozel; photo via Facebook

Additional details and obituaries were not available at press time for two additional recent deaths within the planetarium community:

- Larry Krozel, planetarium lecturer at the Treworgy Planetarium at the Mystic Seaport Museum in Connecticut, on February 19.
- Antonio Cornejo, director for 33 years of the Galileo Galilei Planetarium in Buenos Aires, Argentina, on January 27.



Antonio Cornejo; photo courtesy Planetario Galileo Galilei

"The beauty of the starry sky, the poetry of a full moon night, the magnificence of a sunset, are expectations that arouse love for astronomy."

The stars will never be won by little minds; we must be big as space itself.

Robert A. Heinlein
Double Star

2020 - International Year of Plant Health

- 8 March. International Day of Planetariums, public initiatives between 7 and 8 March. www.ips-planetarium.org/page/IDP
- 25-26 March 25, BT Exhibit & Immersive Theater Design Seminar 2020. Bowen Technovation will host another in its series of design meetings at its year the event will be held at the Indy Public Library Central Learning Curve, Indianapolis, Indiana. Attendance is free and lunch and two breaks area included. Registration is required at bowentechnovation.com/seminars2020/register/
- 29 March. DATE CHANGE FOR Deadline of PlanIt Prize for an original video production, organized each year by Italian Association of Planetaria (PlanIt), Italy. The prize is open to everyone. First prize 500 euro. www.planetari.org
- 22 April 2020. Earth Day 2020, the 50th anniversary of the first Earth Day. The planetariums are invited to collaborate. Earthday.org Contact: Lara Calkivik, Calkivik@earthday.org; download the Earth Day toolkit at www.earthday.org/
- 22-25 April. Middle Atlantic Planetarium Society conference, Cradle of Aviation Museum, Garden City, New York. www.mapsplanetarium.org/maps-2020-conference-announced-save-the-date/
- 24-26 April. Italian Association of Planetaria (PlanIt), Annual conference, Florence Planetarium, Italy. Contact: osservatorio@serafinozani.it; www.planetari.org
- 25-27 April 2020. Gesellschaft Deutschsprachiger Planetarien e.V. (GDP), annual meeting of the German-speaking Planetaria, Galileum Planetarium, Solingen, Germany. www.gdp-planetarium.org
- 13-16 May 2020. Jena FullDome Festival, Zeiss-Planetarium, Jena, Germany; www.planetarium-jena.de, www.fulldome-festival.de
- 15-17 May 2020. Association of French Speaking Planetariums (APLF), national meeting, Cap de la Hague-Planétarium de Ludiver, France. www.aplf-planetariums.org
- 18 May. International Museums Day, icom.museum
- 2-6 June 2020. Conference of Southeastern Planetarium Association (SEPA), Hallstrom Planetarium, Indian River State College, Fort Pierce, Florida, USA. www.sepadomes.org
- 3-5 June 2020. IPS Fulldome Festival Brno, Brno Observatory and Planetarium, Brno, Czech Republic. www.fulldomefestivalbrno.com
- 11-13 June. ECSITE Annual Conference, Kersnikova Institute, Ljubljana, Slovenia. info@ecsitem.eu
- 18-19 June. IPS Fulldome Festival, Edmonton, Alberta, Canada.
- 20-21 June. IPS Council Meeting.
- 20 June. IMERSA one-day pre-IPS event. www.ips-planetarium.org/page/IPS2020-Program
- 21 June. LIPS one-day pre-IPS symposium. ips-planetarium.org/page/IPS2020-Program
- 21-25 June. 25th International Planetarium Society Conference, Tellus World of Science, Edmonton, Alberta, Canada. www.ips-planetarium.org, www.ips2020.twose.ca
- 19-22 July 2020. British Association of Planetaria (BAP), Summer Meeting, Imperial College, London, United Kingdom www.bap.org.uk/summermeeting



- 21-30 July. Spitz Summer Institute. Chadds Ford, Pennsylvania. Dome-based education using the SciDome planetarium; courses cover astronomy, earth science and physics presentation on the dome, teaching astronomy concepts using SciDome curriculum, program creation. Contact jtowne@spitzinc.com or see www.spitzinc.com/Institute.
- 29 July. Western Alliance Conference. Casper, Wyoming.
- 21-25 September. CAP (Communicating Astronomy with the Public) 2020, Sydney, Australia. www.facebook.com/CAPconference/
- 21-25 September. DUG 2020, Digistar User Group, Lucerne, Switzerland.
- 26 September. International Observe the Moon Night 2020. moon.nasa.gov/resources/396/international-observe-the-moon-night-2019-2020-one-pager/
- 4-10 October. World Space Week. www.worldspaceweek.org/events/
- 5 October. Astronomy Day, www.astroleague.org
- 17 October. ASTC Annual Conference (Association of Science-Technology Centers), Carnegie Science Center, Pittsburgh, Pennsylvania. www.astc.org/
- 21-24 October. Great Lakes Planetarium Association Conference, Kalamazoo, Michigan. www.glpa.org/
- 18-20 December 2020. Workshop & Conferenze of small mobile digital planetariums, Planetarium de Marseille, France. www.lss-planetariums.info
- 31 December. Deadline for the contest "A week in United States." For information and application requirements go to: www.ips-planetarium.org/page/WeekinUS
- 31 December. Deadline for the contest "A Week with the GDP." www.ips-planetarium.org/page/Weekwithgdp
- 31 December. Deadline of the prize "Page of Stars." Contact: Susan Reynolds Button, sbuttonq2c@gmail.com; www.ips-planetarium.org/?page=pagesofstars

2021 - International Year of Peace and Trust

- June 22-26, joint SEPA/MAPS/WAC conference at the Bays Mountain Park & Planetarium in Kingsport, Tennessee. The conference site and hotel is the MeadowView Marriott. The theme is "It Takes a Universe," to celebrate the diversity of skills within the planetarium field by highlighting the planetarian, the artist, the astronomy educator, and the student who will fill these rolls in the near future. A Mini-LIPS event is being planned. Details will be released summer 2020. If you have any questions, please contact Adam Thanz: AdamThanz@KingsportTN.gov.

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



April S. Whitt
Fernbank Science Center
156 Heaton Park Drive NE
Atlanta, Georgia 30307 USA
april.whitt@fernbank.edu

"How to make it look easy"

Among the guest speakers at the Great Lakes Planetarium Association meeting in Toledo, Ohio, this past October was Bob Dempsey, flight director for the International Space Station.

His presentation was titled "Making a Mission, or How To Make It Look Easy." (Author's note: Hey—we do that all the time, right?) Flight directors, he said, have a motto: "Don't make the news."

He showed an animation of assembling the ISS, with its multiple modules and months-long time table. After watching components assemble, disassemble and re-position, rearrange and unfurl, Deb Lawson remarked, "And I can't even find lids to my Tupperware."

As complex as assembly was, his description of what-was-supposed-to-be-a-simple mission in 2010 proved it was even more so.

20A, the twentieth American assembly mission, would consist of two modules: Node 3 and the Cupola. Launch the shuttle, install Node 3, attach a few power cables to keep things from freezing. One spacewalk would take care of it all.

Before the mission, "The Plan" was simple.

Then the fun began. This module won't fit next to that module. It was supposed to be down here on the ISS, not over on the end like that. You can't just leave a module without power. The drawings don't show that bolts stick out over there. What about the insulation around that piece? And are there enough supplies for the crew?

When the plan falls apart

After looking at all the pieces, The Plan morphed into a complicated dance of three spacewalks to move modules, reroute electrical/computer/ammonia lines (which required drilling a hole in a pressurized module) (in space), relocate regenerative life support systems (98% of the water on station is recycled), and get the exercise equipment out of the lab and into Node 3.

It was, as Dempsey put it, "analogous to modifying a bedroom by moving the bathroom to the other side of the room."

Of particular concern were the ammonia hoses. Circulating ammonia cools the electronics on the ISS and is critical to its function. During a test on the ground, an ammonia hose exploded, damaging a second line nearby. Analysis seemed to indicate a manufacturing issue, rather than a design problem, so new hoses were ordered with double the braiding of previous hoses. When another hose developed a leak during ground tests, engineers discovered that the welding process made the hoses brittle.

I learned what a "tiger team" is during his presentation. It's a team of specialists, tenacious problem-solvers brought together to work on specific goals. Everyone who knew anything about hoses, welding, or ammonia was brought together to assemble, test and analyze the hoses. With only a few months before launch, the team put together "Franken-hoses" to be installed on ISS, constructed of pieces of hose already tested on the ground, with a new welding technique.

While the methods had been used on previous ISS missions, no hose this long had ever been used, either on the ground or in space. And the mission was a success.

Dempsey mentioned that during a spacewalk in 2001 ammonia crystals formed on astronaut Jim Curbeam's space suit from a small, quickly-stopped leak in an ammonia. As Dempsey put it, "You can't take that

inside. The ammonia will evaporate and kill everyone."

So Curbeam was put in the sunlight until the crystals evaporated before re-entering ISS. Gives a whole new meaning to the phrase "hung out to dry."



NASA loves acronyms. Stephen Colbert loves NASA. His fans voted to name the ISS Node 3 "Colbert," but instead he has an exercise treadmill acronym in his honor. The Combined Operational Load Bearing External Resistance Treadmill is official. NASA

Colbert speaks, his fans listen

NASA has a history of starting online contests for the public to name different craft and ISS nodes. Stephen Colbert, host of *The Late Show With Stephen Colbert*, a late-night television talk show in the U.S., loves to promote NASA and encouraged viewers to nominate his name for what was then called Node 3.

NASA's suggested names for the node were Serenity, Legacy, Earthrise, and Venture. When the votes were tallied, with write-in votes, the winner was "Colbert."

But NASA doesn't typically name space station hardware after living people. Nor, by law, can NASA name a component after a private citizen or a commercial entity. So a compromise was reached. The T2 exercise equipment was renamed Combined Operational Load Bearing External Resistance Treadmill, or C.O.L.B.E.R.T. It even has its own logo.

Node 3 is now officially known as Tranquility.

Fernbank Science Center was fortunate to have the Kansas Cosmosphere's exhibit Apollo 50 Redux on display last fall. The exhibit contrasts NASA's mission control rooms of the Apollo era with those of today. Video interviews with the staff of the historic Mission Control are fascinating.

James Covington was assistant flight director for Apollo 12, and is one of those interviewed.

When the craft was struck by lightning, twice, just after liftoff, and all the alarms went off in Mission Control, he said, "My first thought, my very first thought was, 'C'mon Sim Supe (simulation supervisor), get serious. This isn't real.' And my next thought was, 'This isn't a simulation!'"

☆

VIRTUARIUM X

Fulldome Digital Planetarium Software

From **GOTO INC**



Since the debut of VIRTUARIUM, the first fulldome planetarium, in 1996, GOTO has been developing and improving their fulldome software.

Dozens of Hybrid installations across Japan currently use VIRTUARIUM X as their software engine of choice to run the planetarium.

Now GOTO is releasing VIRTUARIUM X - the latest version of their fulldome astronomy software platform - in the western hemisphere for the first time.



GOTO INC

4-16 Yazakicho, Fuchu-shi, Tokyo 183-8530 Japan
E-Mail: info2@goto.co.jp Tel: +81-42-362-5312
URL: www.goto.co.jp/english/

GOTO USA LIAISON

4044 N. LINCOLN, 204 CHICAGO, IL 60618
E-Mail: mark@goto-stars.com Tel: +1 317 537-2806
Contact : Mark Webb

DOMEX

The LED Dome Has Arrived



Extreme Brightness ♦ Extreme Contrast ♦ Extreme Resolution ♦ Extreme Lifespan



EVANS & SUTHERLAND

www.es.com/DomeX