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## In Front of the Console



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I just couldn't do it yet—show you the real me. Maybe next time. This is the only picture of myself that I like, and it's 30 years old.

One of my favorite lines from the movie *Jurassic Park* comes from Dr. Alan Grant, who says "The world is changing so fast, and we're all running to catch up." He could be talking about the planetarium world, where our community is facing a myriad of challenges—and the pace of change is almost overwhelming.

(Aside: Grant is played by Sam Neill, one of my favorite actors. He was born in Northern Ireland, but moved as a child to the South Island of New Zealand. I guess you can both claim him!)

Grant, of course, is talking about dinosaurs. The situation facing us isn't as dangerous as a velociraptor or as fanciful as cloned dinosaurs, but we are at a technology crossroads. But, before I muse about change, we need to take care of some business.

#### New Address for Planetarian

The *Planetarian* has a new permanent mailing address (see page 2), necessitated by the relocation of Treasurer/Membership Chair Shawn Laatch to Hawaii. Congratulations to Shawn, who became the director of the planetarium at the Imiloa

Astronomy Center in Hilo in December. The Imiloa people made a fine choice.

#### Welcome to the AER

A partnership with the *Astronomy Education Review* debuts in this issue. I'm sure you all know that AER is the web-based, peer-reviewed journal for astronomy education and outreach (and if you didn't, you should check it out at aer.noao.edu). The editors are Sidney Wolff and Andrew Fraknoi, names that are nearly synonymous with astronomy education. The AER especially is interested "in increasing the number of papers relating to education outside the formal classroom." Hey—that's us!

I'll select an AER article for each issue of the *Planetarian*, and if I receive material that is worthy of review by the AER, I'll forward it to them. It's a win-win situation., especially for the *Planetarian*. I would like to see this publication grown in professional status. This is a good first step.

This month's article is by IPS member Stacy Palen from the Ott Planetarium at Weber State University in Utah (and her colleague AmyJo Proctor), and is one I was particularly excited to see: a comparison of astronomy standards across the US.

Once you look at the different states' education standards you'll see what a daunting task this paper took on and completed. I felt that devoting five pages to the comparison table was well worth the space. You can see at a glance which states don't include a lot of astronomy in their science standards, and how planetariums are meeting—and not meeting—what teachers need.

#### "25 Years Ago," Anyone?

Three columns are missing this issue, Anita Sohus' NASA column, and John Schroer's "What's New." John got wrapped up in the GLPA conference, and Anita is still overwhelmed with NASA duties.

I'm at fault for the missing "25 Years Ago column." I'm probably not the right person to be writing it, so I'm tossing it up for grabs to anyone would like to share their writing talents with the IPS community. I think the person who would do justice to the column is someone who's been involved with the planetarium world and the IPS for a long time, perhaps when the events of 25 years ago were taking place. You'll get a personally copied issue of the historical *Planetarian* and my profound thanks.

"Star Stories" is also missing. I received no submissions this month, so it looks like I'll have to go knocking on doors to find them (virtually, of course). Little nudge here: How about someone from India? Is there a traditional star story that you tell that you could share with your colleagues around the world? It doesn't have to be long, and if you have an illustration, send it along.

There are a couple of great pictures in this issue. My favorite is on page 64. It gave me déjà vu shivers because I've seen exactly the same pose at events we've sponsored by Youngstown State University. The same excited, fascinated kids, the same decorated rockets, even the same bicycle pump. The only difference was that really cool hat the one student is wearing. Kids will be kids, regardless of where they live.

#### Change—and More Change

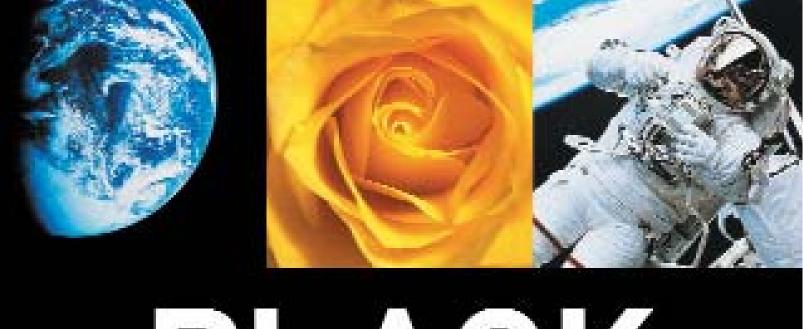
Ed Lantz writes in "Digital Frontiers" about the speed with which the development of all-dome video is moving and the potential for it to present themes outside of astronomy by professionals outside of the dome. It's a strong opinion column (something expected of by-lined columns of this type) and Ed has some valid arguments.

The "fulldome vs traditional" divide hasn't come about because of a lack of desire for all-dome or the willingness to show science topics other than astronomy in our domes. It's money, to put it bluntly. Some "traditional" planetariums will never change to digital because they simply can't afford to. Some of us "hybrids," who have digital/alldome capability, are having trouble "feeding the beast." We have the machine, but not the resources to afford the shows. Come on, guys-\$20,000 for a 50-license for a show? No matter how good it is, a non-profit, free-tothe-public institution (or one working with all volunteers in Mexico or India or Thailand) can't afford \$20,000 for a single program, and what kind of technology will we be using for projection in 10 years, let alone 50?

Another complicated issue is the "print vs electronic" debate. Should we save trees and membership fees and make the *Planetarian* completely electronic (like the AER)? Or should we recognize that the internet is *not* ubiquitous, and still provide a printed journal? It's a tough question, one that has, again, been brought about by technology and money. Let's face it: printing is expensive.

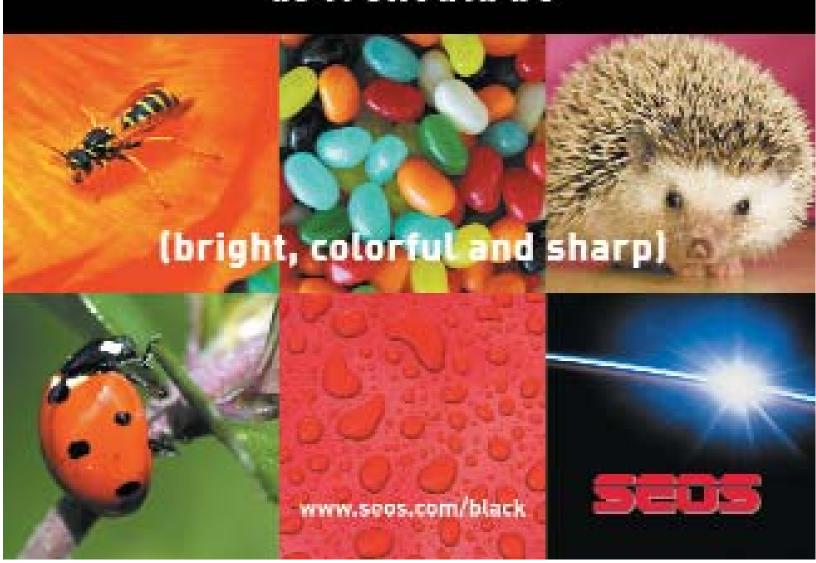
An even more-debated issue is Pluto. At last: something that isn't related to money! Let's apply our reaction to the Pluto decision "intelligently," as Martin George describes in his story on page 34, and not be iconoclastic or intolerant to changes. The IAU is vested with the authority to make this decision;

(Please see **Editor** on page 71)



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as it should be



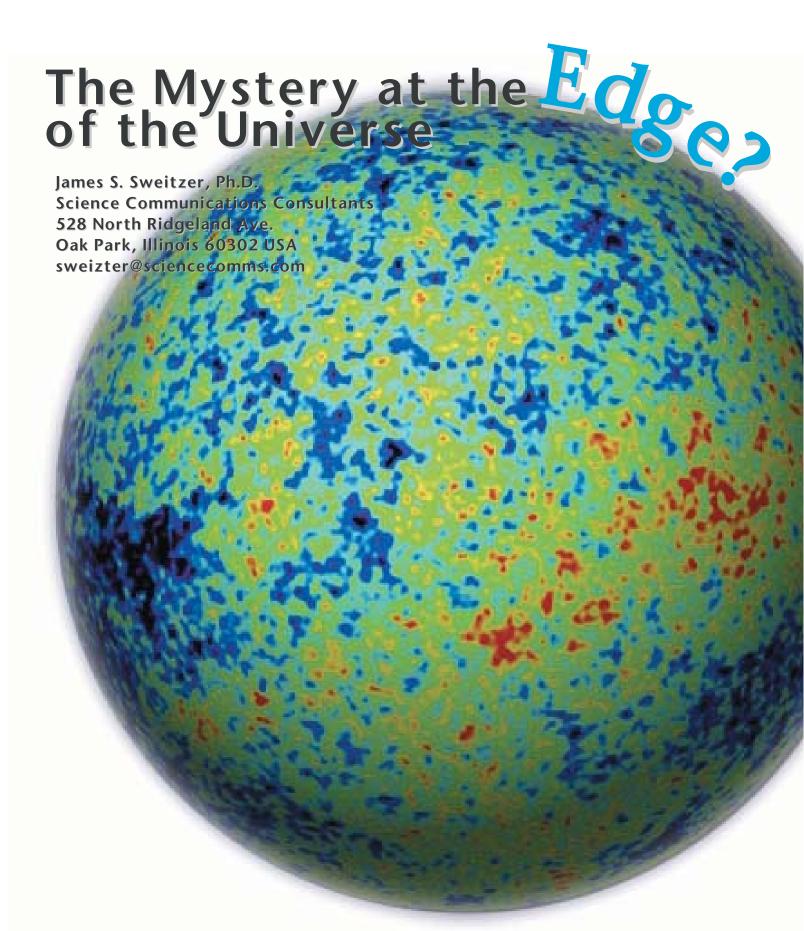


Figure 1: WMAP Sphere: Cosmic microwave background visualized and rendered as a 3-D sphere. <sup>22</sup> All graphics by the author unless otherwise noted; this image courtesy of NASA/WMAP Science Team.

Submitted for publication 9/16/06; Accepted for publication 10/31/06

Abstract: Digital projection systems that can display cosmological-scale models offer both opportunities and challenges for planetarians. The chance of implanting or reinforcing popular misconceptions is high when presenting the WMAP cosmic microwave background data as a sphere seen from the outside. This paper addresses questions about the edge of the universe raised by this depiction. This is done by focusing on drawing the distinction between cosmic maps versus cosmic pictures of an expanding universe. The reader should acquire a working knowledge from this discussion to be able to handle questions from the public about the various edges or, more properly, horizons, that present themselves in cosmological models.

Fulldome digital planetariums¹ have revolutionized what planetarium and astronomy educators need to know. Because these systems can display a scale, 3-D model of the universe, they have extended dramatically the domain over which educators need content expertise. Older opto-mechanical planetarium technology only required the ability to describe and interpret night and day sky phenomena—in other words, basic astronomy. Guiding audiences through a digital universe requires a much deeper knowledge of astrophysics and cosmology.

This is what is hoped to become the first of a series of papers to deal with the pedagogical consequences for planetarians when working with this new technology. We must now confront the fact that we live in an evolving universe where the speed of light (c) is finite. Because c is finite, we need to deal with many issues in interpreting what astronomers observe with telescopes as well as what we can display in visual models. A subsequent paper will discuss virtual travel through stellar databases. This first paper focuses on an important cosmological problem related to a frequently asked question: "Is there an edge to the universe?"

#### Extending beyond the dome

The issues associated with teaching modern cosmology extend far beyond the planetarium dome. Most audiences have only rudimentary mental models of outer space that extend only as far as Pluto<sup>2</sup>. Furthermore, some Americans have a negative attitude towars the Big Bang in much the same way as they do

biological evolution. The latest National Science Foundation Science and Engineering Indicators<sup>3</sup> states:

Americans were less likely than residents of other countries to answer "true" to the following scientific knowledge questions: "human beings, as we know them today, developed from earlier species of animals" and "the universe began with a huge explosion." In the United States, 44% of the respondents in an NSF-sponsored survey answered "true" to the first question in 2004, about the same level recorded in every year (except one) that the question has been asked. In contrast, 78% of Japanese respondents answered "true," as did 70% of the Chinese and European respondents and more than 60% of the South Korean and Malaysian respondents. Only in Russia did less than half (44%) of respondents answer "true." Similarly, Americans were less likely than other survey respondents (except the Chinese) to answer "true" to the "Big Bang" question.

This paper is intended for planetarium and astronomy educators who form the front lines of astronomical education. It is crucial that we, as astronomy educators, have a sound background in aspects of modern cosmology, if the public understanding of contemporary science is to progress. A recent popular science magazine article<sup>4</sup> took great care to discuss common misconceptions about cosmology, but it did not address specific problems planetarians might face using a digital planetarium projection system.

The challenge, however, goes far beyond simply knowing more about stars, galaxies, and cosmology. Because a digital planetarium can display a model based upon 3-D databases, it can engender problems when the models contradict relativity. The intent of this paper is to address one limit of these new 3-D models<sup>5</sup>. To start we will address some misconceptions that can arise from the problem of displaying the cosmic microwave background (CMB).

The CMB data in Figure 1 display the distribution of the variations in the 2.725 K cosmic microwave background, which is the relic electromagnetic radiation from an early epoch of the hot Big Bang origin of the universe. These data were recorded by the Wilkinson Microwave Anisotropy Probe (WMAP) and this figure will often be referred to as the WMAP Sphere. The false colors are emphasized to show the structure of variations in the microwave radiation. In actuality, these variations are quite small, of order one part in 10<sup>-5</sup>. The spatial spectrum and amplitude constrain the cosmological parameters describing the universe. In particular, the WMAP data indicate we live in a spatially flat<sup>6</sup> universe dominated by dark matter and dark energy.

#### Misleading "baby picture"

In digital planetariums, these data can be depicted as the ultimate data set after flying past stars, galaxies and clusters of galaxies. This is because the WMAP data represents the limit of what is observable, at least by microwave telescopes. It has been referred to in writings intended for popular audiences as a "baby picture" of the universe. In that sense, they *are* the

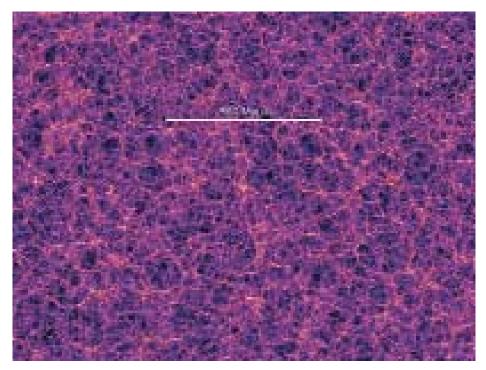


Figure 2: A Cosmic Map of the Universe<sup>23</sup>. This image is 1,500 Mpc/h wide. Using h=0.71 and converting the units to light years, it spans a distance of 6.9 billion light years! This is simulated slice of the dark matter<sup>23</sup> in the cosmos and is still only a fraction of the dimension of what we can know. This simulation is for the present epoch,  $t_0=13.7$  billion years after the Big Bang.

data from the edge of what we can observe. Digital planetarium presenters can then virtually fly outside these data to observe it, as we are in Figure 1.

There are problems implicit in the use of this spherical representation as a visualized model of the universe. This paper will address five and suggest an approach to an alternative interpretation, based upon the construction of a space-time diagram. Even if this alternative is not directly useful in digital planetarium presentations, the hope is that by addressing and learning about the problem of depicting cosmological horizons, astronomy educators will be better equipped to answer questions about cosmology.

We will first look at several important scientific concepts concealed by the problematic WMAP Sphere. From there we will list some possible misconceptions created by ignoring these concepts. Finally, we'll go to some length to examine an alternative way to understand the CMB as the light horizon of a cosmic picture of the universe.

#### Five Problems with WMAP Sphere

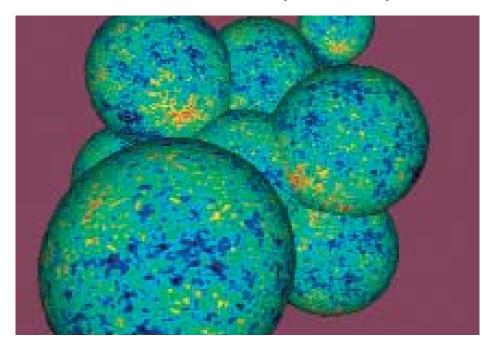
We will first examine some of the concepts that are implicit in any display of deep cosmological data. Understanding them will help frame the use of the Figure 1. There are at least five ideas that limit the use of the WMAP sphere as a model:

• Cosmic Pictures vs. Cosmic Maps: When we observe the universe, we see what has

been called the world picture, not a world map. With this distinction rests many of the problems we aim to solve. (In this paper, when we are talking about the universe as a whole, we will use the more contemporary word *cosmic* instead of the archaic adjective world.) A cosmic picture is literally what we see with our telescopes, or even our eyes for that matter.

Because we rely on light for celestial information, we are constrained to live in a relativistic universe where images of distant objects are actually images of past events. In our everyday life this is never apparent because the distances, typically meters, are so small and c is extremely fast (3x108 meters per second). But in cosmology the distances are enormous, so we can't avoid the fact that we always observe a cosmic picture. If light traveled infinitely fast, then we might see something like Figure 2 when we looked into space. This figure shows a slice of the structure of the universe and is a cosmic map; our common sense understanding of large-scale spatial information is that of a map. The map in Figure 2 was constructed theoretically from the Millennium Simulation of the Virgo Consortium<sup>8</sup>. Where the problem with using Figure 1 arises in a planetarium program is that it is sometimes used in a conflicting way-like a cosmic map, when the WMAP Sphere is in fact simply the horizon of a very early event in our cosmic picture. This paper will elaborate further on this distinction and show ultimately how to envision the WMAP data in a more meaningful way. If the speed of light were infinite this distinction would not have to be made.

• Different Observers mean Different Horizons: Related to the concept of cosmic pictures is the fact that what observers see depends on their location. Different observers on different galaxies will see different cosmic pictures and therefore different CMB horizons. So, if we were to live in a local universe of, for example, eight WMAP observatories in galaxies many billions of light years apart, they would all see their own particular WMAP spheres, like those



 ${\bf Figure~3:~CMB~Spheres~for~Different~Observers.~A~universe~with~widely~spaced~observers~using~WMAP-like~observatories~would~see~similar,~yet~different,~CMBs.}\\$ 

shown in Figure 3. The general statistics of the data of the different spheres would be the same, but the particular figures would not. Cosmic picture are centered on observers, cosmic maps are not.

- Expanding Universe: If the challenge presented by the speed of light was not bad enough, we must add to it the fact that the universe is expanding. Astronomers are, in effect, observing moving targets. By the time we receive light from a distant galaxy, the galaxy is nowhere close to where it was when it emitted that light. Since the light seen by the WMAP9 was emitted 379,000 years after the beginning of the universe, it is highly susceptible to this effect. That is why using Figure 1 to display the edge of the universe is so problematic. As we shall see, at the time that the WMAP light was emitted<sup>10</sup> it was quite close to us-at a proper distance<sup>11</sup> of only 40 million light years!
- Cosmic Horizons: The depiction of WMAP as the horizon of the observable universe has another problem. The photons detected by WMAP have long since decoupled from the material particles from which they were emitted. The CMB should be properly referred to as our *visual* horizon. The actual set of particles (mostly hydrogen, helium and electrons) that last scattered the CMB light define what is called the particle horizon.

As it turns out, the expansion of the universe has stretched this sphere of particles to an enormous proper distance. At the current epoch (13.7 billion years after the Big Bang), the particle horizon is now 41 billion light years away!<sup>12</sup> (We will return to a short discussion of these and other horizons at the end of the article.) Which is the correct boundary to our universe?

Further complicating the horizons problem is that the horizons are different for different observers, as shown in Figure 3. So, an observer 5 billion light years to our right will see a very different cosmic microwave background figure, one dependent on the scattering from a different set of particles.

• Redshifts: Cosmological redshift is a phenomenon observed in the spectrum of distant galaxies. Astrophysicists use redshift as a distance indicator, but it is more precisely related to the change in cosmic scale between the time the light was emitted and when it reached the telescope. Redshift is really a time measure of the expansion of the universe, since redshift (z) and expansion are coupled directly. If the cosmological redshift seen in the spectrum of a galaxy is, then,

$$\mathcal{L} = \frac{\mathbb{R}(J_n)}{\mathbb{R}(J_n)} \mathbb{I}$$

where  $t_0$  is the age of the universe today,  $t_e$  is the age of the universe when the detected light was emitted. R(t) is called the scale factor of the universe, which increases over time. Note that cosmological redshift is due to the expansion of the universe and not the Doppler Effect, a common misconception.

The calibration of distance with redshift is problematic and quite challenging, especially deep in the universe. Astrophysicists typically keep their cosmological data in redshift coordinates, because they usually do not need to know actual distances. Computer systems rendering digital 3-D models need to use distances, so here again is a complication when visualizing deep space data.

#### It's All Relativistic

These five problems arise because we live in a relativistic, expanding universe. Even our concept of distance needs to be revised. We cannot rely on naïve notions of a Newtonian universe with its absolute concepts of space and time. Because the universe is evolving, we really can only define a distance between objects at a particular instant of cosmological time. We denote this as proper distance in the discussions below. The proper distance<sup>13</sup> between two objects changes with time in an expanding universe.

Our common-sense depiction of space is, however, more like a static map with stars and planets represented as tiny balls arrayed in empty space—a map Newton would love. For that reason, it is easy to see why there can be conflicts when using everyday experience to understand cosmological models. We will do a thought experiment to show how different our mundane world would be if the effects of relativity were obvious. But first we must discuss how using the WMAP figure as the boundary for our observable universe can lead to confusion and misconceptions.

## Potential Misconceptions from the WMAP Sphere

When interpreting the boundary of the observable universe as the WMAP Sphere, we might expect several misconceptions to crop up, especially if the digital planetarium operator takes a point of view outside of this figure. Here are three misconceptions:

• Misconception 1: There is an outside to the universe. Figure 1 can imply that there is an "outside" to the universe, not just the observable universe. Cosmologists know that the universe has not been expanding into an exterior space, but is an expansion of space itself. Current flat-geometry cosmologies are even consonant with an infinite universe. Space and time themselves came into being with the Big Bang, so that questions of

outside and inside are really meaningless. The relativistic hot Big Bang model used in science does not need to hypothesize a super-ambient medium. Unfortunately, depicting the CMB as a bounding sphere can reinforce this misconception.

- Misconception 2: There is a center to the universe. When used in a digital program, the WMAP sphere is necessarily centered on our location. This is because all cosmic pictures are centered on the observer. This is not due to any Ptolemaic point of view; it is merely due to the finite nature of c.
- Misconception 3: The Big Bang was like a bomb. By extension from the previous two misconceptions, the public might imagine that the universe was created at a point in space and the matter hurled out as far as the WMAP Sphere. Not only is this cosmologically the wrong way to think of the Big Bang, but it also connotes a chaotic beginning often used by religious fundamentalists<sup>14</sup> to criticize modern science. The origin of the universe was, in fact, quite orderly and anything but chaotic.

In the next section, we will elaborate on the concepts we need to understand in order to make a model or a presentation that will avoid stoking these misconceptions. Even when properly addressed, however, we will see that it will be difficult to circumvent them

This is a challenging knot to unravel, so much of the content in this paper is not appropriate for planetarium audiences. It is, however, easy now to create or reinforce these misconceptions with digital planetariums. We can't avoid the public's questions about the edge of the universe, because it is a boundary question<sup>15</sup>—often such questions have deep meaning for both novices and experts. Nevertheless, these are concepts that astronomy educators must understand and come to grips with in our modern scientific age. If this paper does one thing, we hope to illustrate better the distinction between a cosmic map and cosmic picture and help planetarians explaining or leading discussions about the edge of the universe.

#### **Cosmic Maps vs. Cosmic Pictures**

We live in a universe where the speed of light is high, but it is, nevertheless, finite. So, we need to be very careful how we describe deep space. To understand this effect, we will do a thought experiment on more familiar territory to me—the USA.

A map of the United States—or any country—is one that contains cities, roads, and other features, all of which are contemporaneous to the time of publication of the map. Practically speaking, you want to have the

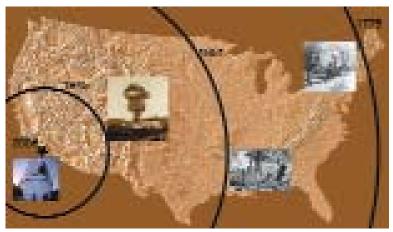




Figure 4 (left): World Picture of USA. Thought experiment showing events in the United States as seen from Mt. Palomar in 2006 if the speed of light were only 20 km/year. Figure 5 (right): Constructing US Picture. This is done from maps different epochs. The green light cone widens as one proceeds into the past, intersecting older and older maps. In the picture view of the US we only see the events where the cone intersects the maps.

most up-to-date road map. If you tried to drive across the country visiting cities along the way, a map from 1926 would be of little use.

It is natural to think of our spatial world being analogous to a road map. With cosmology, however, it is as if we have a stack of maps to deal with. With farther objects, we are confined to older maps.

Matters can become even worse. We only see a portion of the distant maps corresponding to the exact time delay for that distance. Furthermore, people in different locations see different situations. This is the basis of the concept of a world picture, a term first coined by E. A. Milne<sup>16</sup> in the 1930s. Our thought experiment world picture of the United States might help to make this point clear. (See Figure 4.)

To understand this picture, we will start atop Mt. Palomar Observatory in Southern California. The time is the present—2006. Furthermore, assume that we could use the observatory's Hale five-meter telescope to see locations in the continental US. (The atmosphere and the curvature of Earth are the least of our problems in this thought experiment!) To make this analogy strictly parallel to cosmology, now consider what it would be like if the speed of light was only 20 km/year! That's very slow, but not unimaginable. Figure 4 then outlines schematically what we would see.

The three black circles correspond to distances from Mt. Palomar of simultaneous past events. The first circle is the ring from which events from 1945 are just beginning to reach the observatory. On this ring the first atomic bomb test would be occurring in New Mexico. Ring two, three times farther away, corresponds to a date around the time of the American Civil War, 1861. At this distance, the telescope would be seeing, for

example, the battle of Wilson's Creek in Missouri<sup>17</sup>. The Confederates won that first battle west of the Mississippi river. Way out at the eastern edge of the continent, the telescope is just getting information of events in Massachusetts, in particular the midnight ride of Paul Revere on April 18, 1775.<sup>18</sup> This world picture is due to the slow speed of light we have imagined.

A way to see how this world picture is constructed is to imagine a series of maps including events for every year of United States history (or the history of any country) as shown in Figure 5. If the maps were stacked, then what is actually seen in the picture could be determined by slicing a cone back through the stack of maps. The cone would grow in radius by 20 km every year

until it reached all the way to the East Coast. Where this cone sliced the different maps would determine what the telescope saw for that particular map epoch. The events that make up the world picture fix times with locations, so the picture would be entirely different if we were to put the Hale telescope Chicago.

Of course, the previous example is only a thought experiment—but it illustrates what we are dealing with in cosmology.

## Cosmic Picture of a Static Universe

This section will explore the cosmic picture of a static universe that had a fiery epoch in the past and has evolved in local events ever since. (We are not including the effects of expansion at the moment.) Though this is not an impossible model universe to conceive, there is no evidence for it.

Figure 6 is one way to imagine a cosmic picture. If we could take a thin, circular slice (an extension of a great circle, actually) of the WMAP sphere, we could imagine seeing the inside of the sphere. The radial dimension in the slice is challenging to understand

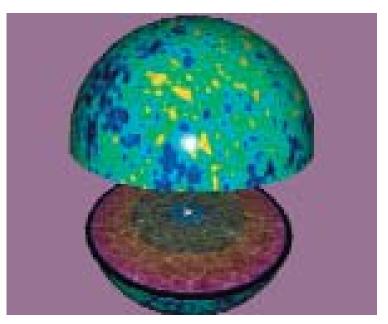


Figure 6. Cosmic Picture inside WMAP Sphere. A great circle<sup>25</sup> slice is shown, if one could see inside the WMAP Sphere. The star at the center represents our location as the observer.



Figure 7. Cosmic Maps for a Cosmic Picture. Source for top four figures is the same as in Figure 2. The bottom figure, representing the time of the CMB emission, is adapted from WMAP data. Note that this is a space-time diagram.

because the universe has changed size with time. Although it is a spatial dimension, we are really looking back in time. We see earlier and earlier in time as we look outward, since the light took longer and longer to reach the origin. To construct a more meaningful representation of a cosmic picture for a static universe, we will have to create a space-time diagram similar to our US picture thought experiment above. It will be similar, except for the fact that we must suppress one spatial dimension.

Figure 7 shows a set of cosmic maps starting with the present epoch  $(t_0)$  at the top and tracing back downward to the epoch of the CMB emission  $(t_d)$ , where d stands for the epoch when light decoupled from matter. An arrow for the time dimension is indicated. The other two dimensions in this perspective are spatial dimensions. These individual maps should be thought of as continuing on indefinitely in their spatial directions. The edges are shown as squares only for convenience.

The maps are based upon a theoretical simulation of the structure of dark matter. The galaxies that we would observe are arranged along this superstructure network of dark matter. The fact is, however, we cannot actually observe a map of the real universe, since we must rely on light from the galaxies for their positions to be known. So, here we need to use theoretical cosmic maps.

To understand the origin of a cosmic picture, we will draw upon the lessons from the USA example. Now we imagine piercing the cosmic maps with a cone going backwards in time. Figure 8 shows this construction. As the observer, we are at the apex of the cone. It widens going back in time because we are seeing farther and farther distances at earlier and earlier epochs.

Figure 8 is a space-time diagram just like

before. The cone is often referred to as our backward light cone. This cone is the surface, in space-time coordinates, that we see when we observe the universe along a particular two dimensional spatial plane. If we now eliminate the parts of the past cosmic maps that we do not actually receive light from and concentrate only on the light from each plane that has actually reached us along the cone, we get the cone shown in Figure 9.

When we observe deep into space, along a great circle on the sky (the celestial equator, for example), we are observing the surface of a past light cone. This is a cosmic picture. Unfortunately, we are limited to being able to visualize in 3 dimensions, so suppressing one spa-



Figure 8. Construction the Cosmic Picture from Cosmic Maps. Here the backward light cone is shown intersecting with these maps. The intersecting points will make up parts of our Cosmic Picture.

tial dimension in order to include time was necessary. Different great circles on the sky result in different cones. The details might be different, but the general features will be the same

Being able to imagine the universe with a time dimension is crucial for an accurate understanding of the edge of the universe. We may have to lose one space dimension, but in return we will now able to understand the universe as it changes scale over time. The representation in Figure 9 is for a static universe. When space itself is allowed to expand, the cone will change shape dramatically. This will lead us to our ultimate goal of a cosmic picture of the expanding universe.

## **Cosmic Picture of an Expanding Universe**

We will now create a space-time representation of a cosmic picture in an expanding universe. To preview what will happen, consider Figure 10 (on page 12). What used to be a cone with a wide base has now wrapped back to its central time axis. In Figure 10, time is again along the axis of symmetry through the central axis. The present epoch (t=t<sub>0</sub>) is at the apex of the cone and is away from us in this view. At the bottom pole, tilted toward us, is epoch t=0, or the beginning of the universe, which is just before t<sub>d</sub>. The green arrows show the two directions of space being represented. These distances could be any x-y plane in space and, again, are proper distance coordinates.

This drop-shaped surface is what happens to the backward light cone when, in the far

distant past, the scale of the universe was smaller. The drop shaped surface represents, then, a dynamic, expanding universe. Curiously, the light received from very early times was emitted from a proper distance that is closer and closer to the time axis.

The shape of the surface comes from a simple model of the expanding universe starting around the time of the emission of the WMAP light, but before the effects of acceleration will become dominate in the distant future. We will see that the WMAP light was emitted near the very bottom of this drop shape. This shape is a space-time version of our world picture.

This drop shape results from a straightforward, though mathe-



Figure 9. Cosmic Picture of a Hypothetical Static Universe. Shown in space-time coordinates. The observer is at the apex of the cone and the CMB is near the very bottom of the cone.

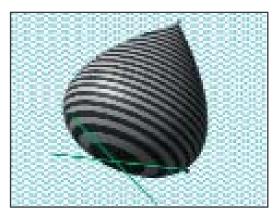


Figure 10. Backward Light Drop in Expanding Universe. See text for explanation.

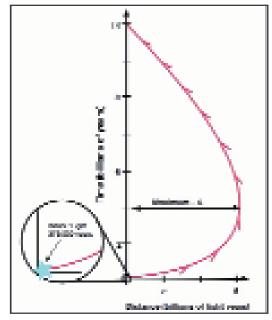


Figure 11. Proper Distance of Emitting Event versus Emission Time. The red line depicts the proper distance from which light was emitted in the past. See Appendix for the derivation and text for detailed explanation.



Figure 12. Cosmic Picture of an Expanding Universe. This is a space-time diagram. Time is shown by the vertical yellow arrow. The spatial distance is represented by the ring coordinates below the drop-shaped surface. This surface depicts the locus of events that form our cosmic picture along a hypothetical great circle in the sky.

matical, understanding of how light travels in an expanding universe<sup>19</sup>. (See the appendix for the mathematical details.) The net result of the calculations is plotted in Figure 11. The red line shows the path of light from objects at a different time now reaching us at today's epoch, t<sub>0</sub> =13.7 billion years. The horizontal distance, for a given emission time, is the proper distance an object was away from our position when it emitted the light observed today. This curve illustrates several important features:

- In our more recent past, more distant objects are emitted the light we see at greater and greater proper distances. This is just like the static universe model above.
- There is, however, a maximum

proper distance! It occurs almost 10 billion years ago, or 4 billion years after the Big Bang. This is a rather surprising conclusion. At that time the scale of the universe was fourninths as large as it is now, which corresponds to a redshift<sup>20</sup> of 1.25. So, a galaxy with redshift 1.25 is the farthest distance anything has been away from us. This is not an extremely high redshift at all! Galaxies and quasars with higher and high-

er redshift were actually closer to us in proper distance when the light we see started on its journey.

- Prior to 10 billion years ago more and more distant objects emitted their light from closer and closer proper distances. This might seem puzzling, but it is a natural conclusion, considering the universe started from a very compact state.
- The WMAP light was actually emitted from a very tiny bottom corner of this curve. The circle in Figure 11 shows a magnified version.

To properly see this as a three dimensional cosmic picture, we need to rotate the curve about the time axis and orient

that axis vertically. Figure 12 shows the final result. The backward light cone from before, which is the surface of the cosmic picture, is more like a backward light drop. This illustration shows the space and time dimensions as before. The colors are included on this surface primarily to help one see the structure of this drop shape. Here are some things to remember and notice about the geometry of this cosmic picture:

♦ This is this shape of our cosmic picture for one great circle on the sky. Time is the vertical axis, with  $t_0$ =13.7 billon years, today, at the top. At the bottom of the pole is time t=0. Strictly speaking, the analysis described here only holds back to the time of the emission of the WMAP light. This time is called decoupling and occurred at time  $t_d$ =379,000 years. In the units on this plot, this time is 0.000379 billion years. This makes it barely visible at the bottom.

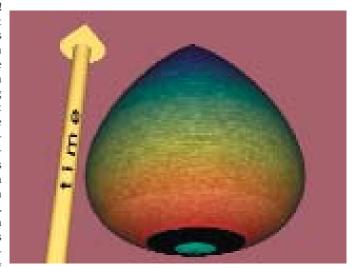


Figure 13. Bottom of Light Drop. This is the view of our world picture focusing on the early epochs of the universe. The emission location of the CMB is shown as a blue-green disk. Note that this disk has been made large to illustrate the point of this article. If drawn to scale, it would be about 300 times smaller than the diameter of the light drop.

Figure 13 shows a view of the bottom of the comic picture drop. The blue green area is where the CMB was located when it emitted the light we see today. Note that it has been exaggerated for this illustration. The WMAP light has traveled along the entire outside shape of this drop to reach us today.

♦ Although it cannot be depicted to scale, even on this figure, the proper distance at which the CMB was emitted is really only about 1/340th of 13.7 billion light years! That comes to a mere 40 million light years away. Rather than being from the current edge of the universe, the light that makes up the WMAP Sphere started on its journey from a distance far less than the present proper distance of Virgo Cluster of Galaxies!

## So what's a planetarian to do?

When we visualize our cosmic picture in expanding space-time, we receive a new perspective on the question of the WMAP CMB data and the edge of our observable universe. Viewing a sphere from the outside (Figure 1) is not really a good strategy. We will not want to use space-time diagrams in public planetarium programs, but by understanding the backward light drop shape of the cosmic picture and the concepts on which it is based can help us make a few

- There is a difference between a cosmic map and a cosmic picture. Planetarium educators often speak of the light-travel time from different stars. Now it is time to put the universe in that perspective and understand that our view of space is entangled with
- time. We live in a space-time universe.
- Our view of the universe depends on our location within it, both in space and time. Every observer sees a different world picture, due to the speed of light and the fact that our universe has been expanding for 13.7 billion years.
- Rather than thinking of boundaries and edges, it makes more sense to think of horizons. A good analogy is a horizon at sea. Such a horizon is far away and a limit to our view, but it is not the edge of the world or even the edge of the sea for that matter. And horizons are different for different observers, just the point we made previously.
- Of horizons, there are three to consider. Figure 14 shows a cut away of three nested spheres in 3-D space. These distances are proper distances. Two are at the present epoch and one is at the epoch of the creation of WMAP. The observer is at the very center. The tiny innermost blue-green dot is at the distance from which the WMAP CMB was emitted, a mere 40 million light years away. We should call this our visual horizon. It is, in fact, too large on the scale of this figure.

The outer sphere represents the particle horizon. This is where the matter that scattered the WMAP CMB light is at the present epoch. Today it's



Figure 14. The Three Horizons. Imagine slicing a sphere in half, centered upon our location. The radius represents the proper distance of three important horizons at two different times. The blue dot in the center represents the Visual Horizon, or proper distance at which the WMAP light was released upon its journey to us (40 million light years in radius and is actually ten times too large in this figure). The pink sphere is 20.6 billion light years in radius and represents the Speed of Light Sphere or the total proper distance light has been able to travel in the expanding universe since the Big Bang. The outer, greenish sphere is the Particle Horizon, which represents the current proper distance of the particles that originally last scattered the WMAP light. The Particle Horizon radius is two times that of the Speed of Light Sphere, or 41.1 billion light years distant.

some 41.1 billion light years away! This is more than 1,000 times farther away than the blue dot! Needless to say the universe has been expanding much faster than the speed of light<sup>21</sup>. The intermediate sphere is the distance where space is indeed receding at the speed of light. It is called the Hubble Horizon and is currently 20.6 billion light years away.

These pedagogical points should be enlightening, but they still don't address the more practical question: How do we deal with questions about the edge of the universe? The strategy as planetarium educators should contain at least these three approaches:

look for boundaries related to the CMB and limit the scope of the question to a current scientific cosmological model, we arrive at the answers above. This strategy is a bit of a cop out, because it is only related to observable phenomenon. Doesn't the theory upon which our model is based make a prediction? Indeed it does. We observe the geometry of the universe to be flat. A flat universe like this could well be infinite. Even if it is extremely large, it still makes even our particle horizon seem like a very local boundary-more like the edge of our neighborhood.

• Limit the Question. If we

• Understand the Limits of the Common Sense. More fundamentally, it seems that our cosmological notions of space and time are bound up with the concept of the expanding universe. Both space and time came into existence with the Big

Bang. Asking about what's outside the universe is really an inadmissible question—a question outside of the rules of our scientific model for the universe. We simply can't take our everyday concepts and language and hope that they apply to the extremes of space-time. Every-day concepts don't apply in the quantum world of the atom, so why should common sense work for cosmology?

• Develop an Understanding of the Use of Scientific Models. So, is all this effort worth it for such an esoteric cosmological concept? The answer is yes, if we wish to continue to stay enlightened in our scientific age. And since most educated people carry some sort

of mental model of the Big Bang in their minds, it is worth working on refining that model. In the end we may not make everyone think like a cosmologist, but at least we might help them understand a more accurate model and help them critically discuss its implications and limitations.



Figure 15. Ceiling of Grand Central Terminal. An example of how a misconception about the edge of the celestial sphere literally became set in stone. Courtesy of N. de Grasse Tyson

#### Coda: A Cautionary Tale

The failure to understand real versus fictional boundaries in space has led to at least one spectacular failure in the past. An astronomically knowledgeable person gazing at the ceiling of New York City's Grand Central Terminal will witness an egregious error. The stars are backwards! (See Figure 15.) The reason

for this is that the artist who created the mural designed it from a celestial globe. A celestial globe is another fictional perspective, just like that of the WMAP Sphere.

In the case of the Grand Central Terminal ceiling, there is a confession that what is depicted is not really what is seen in the sky. The explanation written on a wall plaque states:

The Grand Central Terminal ceiling portrays stars of the Mediterranean sky in the summer. Said to be backwards, the sky is actually seen from a point of view outside our solar system.

If only the creator of the terminal's ceiling had understood the solar system model this would have been avoided. Let's hope that our depictions of the modern cosmological models are free of excuses and also valid for viewers far beyond the Mediterranean!

#### Acknowledgements

The spark that ignited this article occurred under a digital sky in fascinating discussion with Carter Emmart, Carolyn Petersen, and Steve Savage almost two years ago. I would like to thank Stephen Soter for pointing out the distinction between world maps and world pictures to me many years ago. I would also like to thank Sean Carroll of the University of Chicago for clarifying my own cosmological misconceptions. I would finally like to thank Neil de Grasse Tyson for the picture of Grand Central Terminal.

#### **Endnotes**

- <sup>1</sup>The arguments and discussion also apply for flat-screen display of these scientific models. In this paper we will use the term digital planetarium to mean any system that projects a contemporary model of the universe, from planets to stars, galaxies and beyond.
- <sup>2</sup> The intense recent debates over Pluto's status as a planet could be explained, in part at least, because it inhabits the limit of most of the public's model of the universe.
- <sup>3</sup> NSF, Science and Engineering Indicators 2006. See Chapter 7, Public Attitudes and Understanding, at www.nsf.gov/statistics/seind06/c7/c7s2.htm#c7s2l1.
- <sup>4</sup> Lineweaver, C. H., and Davis, T. M., "Misconceptions about the Big Bang," *Scientific American*, March, 2005, pg. 36. This is an article every planetarian should be familiar with.
- <sup>5</sup> Two 3-D digital planetarium systems powerful enough to encounter the problem addressed in this paper are Sky-Skan's DigitalSky2 and Evans & Sutherland's D3. The problem can also occur when using other modeling software, like UniView (www.scalingtheuniverse.com) and Parti-

#### **Appendix**

#### Derivation of the Shape of the Cosmic Picture in Space-Time

The light reaching our telescopes detect travels from the past along the following simple path, called a null geodesic in General Relativity:

$$R(t) \propto t^{2/3} \tag{5.1}$$

In this equation:

t is the proper time that we measure at our position riding on a galaxy

r is the proper distance in dimensionless coordinates

R(t) is the size scale factor of the universe. The functional dependence of R on t comes from a solution to Einstein's Equations of General Relativity. In this paper we will use the convention that R has units of distance

We are interested in the matter-dominated epoch of the universe, the time after  $t_{d^\prime}$  when the light of the CMB was emitted. This is the time after the WMAP light was emitted. WMAP results also show that the geometry of the universe is flat. What this means is that R(t) has a simple form:

$$c^2 dt^2 = R(t)^2 dr^2$$
 5.2

The expansion expansion factor looks like tht shown in Image I.1.

Note that R(t) starts out at zero at time =  $t_o$ , the beginning of the universe, and grows with time until its current scale size,  $R(t_o)$ , where today is  $(t_o)$ , which is 13.7 billion years from the beginning. Note that this scale factor R is what describes the expanding universe. The galaxies are not flying apart through space, since their coordinate positions r do not change. Space itself is expanding carrying the galaxies with them. This is what leads to Hubble's Law and the redshifts we see.

Note that the above expansion factor does not take into account that the universe is observed now to be accelerating. This recent cosmological observation is not expected to make a significant change in the current analysis, which is focused on the past. But, it could make a dramatic difference in the distance future.

Armed with 5.1 and 5.2, we can now calculate the shape of the past light cone or cosmic picture in such an expanding universe.

First define the radial distance coordinate:

 $l(t_e)$  = proper distance corresponding to a time  $t_e$  when light was emitted from a galaxy we see today in our Cosmic Picture. Note that  $0 < t_e < t_o$ 

 $I_e$  will describe our past light cone. We get it by integrating equation 5...

$$l(t_e) = R(t_e) \int_{t_e}^{t_0} \frac{cdt}{R(t)}$$
 5.3

But, 5.2 allow us to substitute for the functionality of t, leading to

$$l(t_e) = t_e^{2/3} \int_{t_e}^{t_0} \frac{cdt}{t^{2/3}}$$
 5.4

Integrating, we get:

$$l(t_e) = 3c(t_e^{2/3}t_0^{1/3} - t_e)$$
 5.5

If we insert  $t_0$  = 13.7 billion years and use billions of years for  $t_{e^i}$  we can drop the c to make l in units of billions of light years.

$$l(t_e) = 7.2t_e^{2/3} - 3t_e \text{ billion light years}$$
 5.6

This relatively simple equation is, then, the result we are looking for. It describes our backward light cone or cosmic picture back to the time of the emission of the WMAP light. It is plotted in Image 11 in the body of the paper.

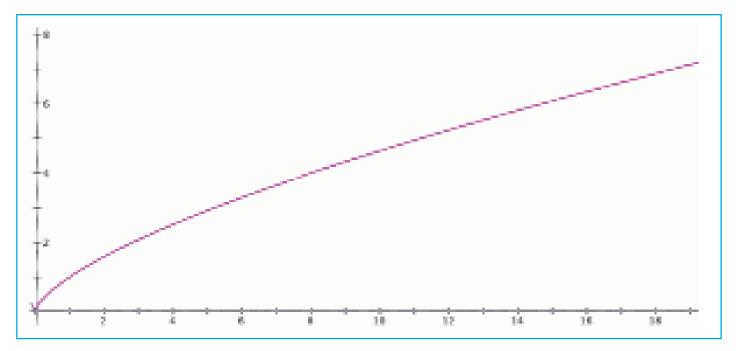


Image I.1. Expansion factor R in a flat, matter-dominated universe. Time is along the horizontal axis.

view (haydenplanetarium.org/universe/partiview).

- <sup>6</sup> Flat, in this usage, refers to the geometry of space itself and is not a literal label. If it were literal we would be living in Edwin A. Abbott's *Flatland, A Romance of Many Dimensions* (Dover 1992). Here it means that the geometry of space is the same as we learned in high school. In particular, any triangle drawn in a flat universe will have its three angles sum to 180 degrees. Four dimensional space-time, however, is not flat because it is expanding.
- <sup>7</sup> Traditionally these have been called world maps and world pictures. See for example Ellis, George F. R., and Williams, Ruth M., Flat and Curved Space-Times, Oxford University Press, 2000. But since the use of the word world to refer to the wider universe is archaic by now, I've chosen to stick with cosmic.
- 8 www.virgo.dur.ac.uk/new/index.php
- <sup>9</sup> This and other numbers about the age of events in the big bang model used in this paper are based on the results of the WMAP mission and can be found at map.gsfc.nasa.gov/index.html.
- Emitted is technically not the right word, but it sounds better here. The light that formed the WMAP image was scattered from particles in the early universe. Cosmologists call it the surface of last scattering.
- <sup>11</sup> Proper distance is a term that will be used throughout this paper. It is defined as the physical distance you would measure between two simultaneous events. It is an invariant quantity in relativity.
- <sup>12</sup> To be 41.1 billion light years distant at the

- present epoch (13.7 billion years) should not be paradoxical. The expansion of the universe is measured by the Hubble parameter. For any value of the Hubble parameter and a large enough universe, one will always have regions farther than the Hubble radius or speed of light sphere.
- <sup>13</sup> To be more precise, we would talk about the distance between the world lines of two objects. A world line is the path traced by an object in space-time. My position sitting in one place as I write this is just a dot in normal spatial coordinates. But, if we include time as a dimension, then even if I don't move in position, I am streaking through time. My world line, even if I'm stationary, extends in the time dimension.
- 14 See, for example, www.spotlightministries.org.uk/bigbang.htm:, where it is stated: "... how can such order and complexity that we see in the universe and living things be created from such a disorder as a big bang? Common sense tells us that a big explosion results in a big mess. No one would argue that a work of art came about as the result of an explosion in a paint factory. The Bible tells us that the design of the universe that exists all around us is evidence of an intelligent designer (Ps. 19:1-4; Rom. 1:20)."
- <sup>15</sup> A boundary question is one that addresses knowledge at its limits. "What happened before the beginning of time?" is a boundary question. So too is the question of extraterrestrial life. Boundary questions usually ask about issues of deep meaning for most people: life, the universe, and everything.
- <sup>16</sup> Milne, E. A., Relativity, Gravitation and

- World-Structure, Oxford, England, Clarendon Press, 1935.
- 17 www.nps.gov/wicr
- <sup>18</sup> www.historyplace.com/unitedstates/ revolution/revwar-75.htm
- <sup>19</sup>This is based upon work by Ellis and Rothman, "Lost Horizons," Am. J. Phys. 61 (10) October 1993, pg. 883.
- $^{20}$  The redshift ( $z_{\rm m}$ ) of a galaxy that was the *maximum* distance from us when the light was emitted can be determined as follows:  $z_{\rm m} = R(t_{\rm 0}) / R(t_{\rm m}) 1$ . When the ratio of R's of 9/4 is plugged in, this yields  $z_{\rm m}$ =1.25.
- 21 This is not really a problem. The speed of light limit only holds to motion within space. It doesn't apply to space itself. Any region of space beyond the Speed of Light Sphere is moving away from us superluminally.
- <sup>22</sup> WMAP Data projected onto a sphere, from: http://map.gsfc.nasa.gov/m\_or.html, courtesy of NASA/WMAP Science Team.
- <sup>23</sup> Map is from Springel, et al., Simulating the Joint Evolution of Quasars, Galaxies, and their Large-Scale Distribution, arxiv.org/ abs/astro-ph/0504097.
- <sup>24</sup> Some 22% of the Universe is made up of dark matter as opposed to 4% being made of normal atomic baryons. The gravitational accumulation dark matter controls the show interms of determining the structure of matter. The baryons then simply follow the lead.
- 25 A great circle is an imaginary circle tracing all the way around the celestial sphere, with the observer at its center. The celestial equator is a great circle. So is the ecliptic.

## The Continuing Challenges of Canada's Creative Consortium

Pierre Chastenay<sup>1</sup>, Alan Dyer<sup>2</sup>, Erik Koelemeyer<sup>3</sup>, Scott Young<sup>4</sup>



With our first national show, *The Quest For Origins* (described in the June 2005 *Planetarian*), we focused on leading-edge Canadian research about the origin of stars, galaxies, and the universe. As if that wasn't a big enough topic, for our second joint venture we chose a show about the prospects for alien life.

The production process began in June 2005 with a face-to-face meeting in Montréal among the partner facilities: the Montréal Planétarium, the Planetarium at the Museum of Man in Winnipeg, the TELUS World of Science in Calgary, and the H.R. MacMillan Space Centre in Vancouver.

The show, *Is Anybody Out There?*, opened simultaneously on May 20, 2006, at all four theatres—on time and on budget.

#### **Leveraging Money**

We created our consortium first and foremost because it offered a way to get more money to produce shows. For our latest project, the production budget was \$310,000, up

In 2004, a group of four planetariums in Canada came together to co-produce a major astronomy show that played across the nation. Perhaps rather foolishly, a year later we actually decided to do it again, this time with a production far more complex.

considerably from our first consortium show. While small by most standards for a documentary production, that figure is still 10 to 20 times the normal budget of a single show produced by any our partner facilities on their own. So, by pooling the resources of four theatres, we increased our production budget by a factor of 10.

Of the \$310,000, about half was covered by grants, while the remainder was brought forward as in-kind contributions from the four partners (essentially, salaries of the many people involved in this project) and a few external consultants (mostly scientists and educational experts). Outside funding

came from federal government agencies: the Museum Assistance Program of Heritage Canada, the Canadian Space Agency, and the National Science and Engineering Research Council.

While we were still required to contribute a lot of our own staff labour (we did not and could not simply hire a production company to do it all for us), the grant

funds made it possible for us to extend the production values beyond what any of us could afford on our own. For example, we were able to conduct extensive location shooting, including on-camera interviews with experts ranging from SETI researchers to scientists working on extremophile life in Arctic Canada.

Would one of the partner institutions, given the same amount of money, have produced a show of the complexity of *Is Anybody Out There* on their own? Undoubtedly, yes. Each institution has the talent and know-how to produce excellent planetarium shows, though "big budget" programs could be produced locally only with the help of costly consultants and contracted labour. Instead, we distributed most of the work amongst ourselves, making use of the production expertise we already had

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<sup>&</sup>lt;sup>2</sup> TELUS World of Science (contact: alan.dyer@calgaryscience.ca)

<sup>&</sup>lt;sup>3</sup> H.R. MacMillan Space Centre (contact: ekoeleme@hrmacmillanspacecentre.com)

<sup>&</sup>lt;sup>4</sup> Manitoba Planetarium (contact: scyoung@manitobamuseum.ca)

At Left: The hosts were composited with friendly ETs for this "dancing with aliens" scene and other sequences that had the hosts interact with computer-generated characters. All the composites and effects had to be done twice, for the English host (Dave Kelly, left) and the French host (Patrick Masbourian, right). All images courtesy of the Canadian Planetarium Consortium

on our respective staffs. This made it possible to produce a high-quality show within an affordable budget.

The other reality for us in Canada is that one institution alone probably would not have been able to secure federal grants. Leveraging those funds was possible only because we were applying for them as a group, for a program that would play both in English and French across Canada. We've found that when planetariums speak as a group they are loud enough for governments and other funding agencies to hear. A grant from one agency is often enough to secure grants from other agencies.

In effect, this is the "Canadian model" for financing and producing programs: work together across the country's various regions and in both official languages to leverage funds from national sources, usually government departments or arm's length agencies. It may be a uniquely Canadian process that does not translate to other countries, but we offer it for consideration.

#### Consortia, not Committees

While jointly producing a show is a challenge, the fact that our group is small, just four facilities and not dozens, made it feasible. Each took on specific production tasks under the direction of a single lead facility. We like to think we were able to avoid much of the "production by committee" syndrome that is the downfall of many joint ventures: projects that either get stalled in bureaucracy or, if they do get completed, look like they were compromises to please a sprawling committee, not an audience. In our case, any science advisors we brought into the process did only that-advise. The planetariums, and in particular the lead facility, had ultimate creative control as we're the experts on show production, not the research scientists. Developing a sense of trust between the creative and scientific sides is something we've never had an issue with.

The writing of grant proposals was undertaken by the Montréal Planétarium in 2004. After funding was approved early in 2005, we divided the production tasks along the lines of each facility's area of expertise. Writing the script and directing the show production was done by Alan Dyer from Calgary. Principle photography and preparation of panorama scenes was assigned to the Manitoba Planetarium and their expert pho-

tographer Hans Thater. Financial management and the many tasks related to the French version of the show were the specialty of Pierre Lacombe and Pierre Chastenay of Montréal Planétarium, while in Vancouver Erik Koelemeyer concentrated on the 3D animation work. Staff at each facility (the credit roll lasts several minutes!) took on additional work preparing materials shared by all facilities: location video shoots, graphic artwork, computergenerated alien landscapes, marketing materials, the final edited video, as well as performing all the local installation tasks.

#### Taking It to the Next Level

To qualify for national funding, our shows have to be produced in both French and English. For our first consortium show, *The Quest for Origins*, we played it conservatively and used voice-over actors to provide the narration. That made it easier to create parallel soundtracks with

identical timing. Even so, we can't just run a parallel second-language soundtrack, as all on-screen typography (the animated title sequence, for example) must be in either one language or the other. Two versions of the video tracks are always needed.

For *Is Anybody Out There?* we decided to dump the omniscient off-screen narrator

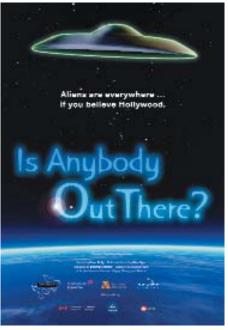
All-sky images anchored most of the scenes in the show, but to avoid visual monotony, the all-skies came in several varieties. Some were image collages for use with video and other effects (above). Others were real-life scenes shot on location (below), such as the perpetual springs on Axel Heiberg Island in the high Arctic, an analog for what might be found on Mars.



(the bane of many a boring planetarium show) and go with a host who appears on camera, usually amid some alien setting. We wanted a host with a hip, MTV-style of delivery to create a casual "blue-jeans-and-T-shirt" feel to a show that did not take itself too seriously, yet did not skimp on the science. An on-camera host could talk in a



The show was punctuated by on-camera experts providing their thoughts about alien life. Some, such as Frank Drake of the SETI Institute, were shot on location with portable gear and backdrops. Others were shot in the more controlled environment of a TV studio. All were masked, framed and by-lined, and often projected as one element of a larger immersive scene.





The show answered the question so often asked of all astronomers, "Do you believe in life in outer space?" The program was also produced in French, as Seuls dans I'Univers, and served as one of the highlights of the Montréal Planétarium's 40<sup>th</sup> anniversary celebration.

friendly, unscripted style, asking questions as much as providing information—important for a topic where there are more questions than answers. Most importantly, the host provides the central focus to the show, serving as an identifiable element the audience can return to, rather than be lost, drifting through space with only a god-like voice as a guide.

#### **Dealing with the Demon**

For the on-screen talent we sought out personalities from pop culture and youthoriented TV programs, not scientists. But we feared the headaches that shooting two different hosts, in two different languages, at two different locations would entail when we tried to sync them up in soundtracks that, ideally, should have identical timing.

Well, it worked. The success was largely due to Montréal working hard at producing a tightly edited and reworded French translation of the script. As a result, the French host's on- and off-camera narration synced up remarkably well to the previously recorded English host, even coming in shorter in some sections, unusual for French vs. English narration. That demon proved not to be as formidable as we had feared. As a result, future shows will use lively on-camera talent—it makes any documentary much more accessible, friendly, and fun.

You might think the French version need only be a good translation of the English script. Not so. There are cultural differences to deal with, even within the same country. The French version of the show was localized with references to pop culture familiar to residents of Québec—French music where we could, references and clips from French TV shows, and phrases and attitudes expressed differently. Ensuring the French version, titled *Seuls dans l'Univers? (Alone in the Universe?)*, worked for the Québec audience was a big part of Montréal's role in the show.

Location shooting was largely Winnipeg's responsibility. The demands of the show took Hans Thater across the continent, including stops in California at the new Allen Telescope Array, as well as a threeweek trip to "Mars analog" sites on Axel Heiberg and Devon islands in the Canadian Arctic. The result was a stunning set of reallife panorama scenes.

For imaginary alien worlds, Calgary's digital artist Brett Pawson used 3D landscape modeling software to create scenes with detail and lighting so intricate they taxed our ability to render them. Providing visual contrast to the landscape scenes were a series of dome-filling collages. Calgary's Darrell Ward created several tunnel-like scenes lined with science fiction posters and Mars probe images. Other collages were designed by Montréal's Sophie DesRosiers. Sophie's beautiful all-skies were often used as backdrops for video clips, giving the impression of immersive video despite the show's conventional projection technology.

#### Scientists and Songs

In *Quest for Origins* we put four astronomers on video in scripted cameo appearances, each introducing a segment of the show. With *Is Anybody Out There*, we raised the bar a few notches and shot nearly two dozen astrobiology experts on video, sometimes in a studio but often by going to them and shooting them against a portable green screen in their offices or labs.

The interviews were conducted by Alan Dyer and Vancouver's video crew at such locations as the SETI Institute in Mountain View, California, USA: the University of Washington in Seattle, USA (for Peter Ward and the Rare Earth hypothesis); in Victoria, at the University of Victoria and the Herzberg Institute; and in Vancouver with researchers from the University of British Columbia and Simon Fraser University. French interviews were arranged by the Montréal Planétarium and conducted in Montréal with scientists from the Canadian Space Agency, the Université de Montréal, and McGill University.

The hours of videotape were edited down to several MTV-style interview montages that punctuate the show, with each expert adding just a choice "sound bite" phrase or comment, sometimes just a word. We wanted to include real people in the show, and have them present the diversity of opinions, pro and con, about the prospects for alien life. Yet we wanted to avoid dull "talking heads." We think the final mix did that, adding energy and pace to the show, as well as putting a face on the science, balancing fact and fiction, and providing evidence and opinion.

The work of selecting scientists who would be good on-camera and the logistics of arranging for all the interviews added another level of complexity to the show. Some experts spoke only in English, for example, and some also in French for the French version of the show—but the extra work was worth it.

#### **Tracking Down the Tracks**

Soundtrack production was contracted to Canadian composer Donovan Reimer. In addition to original compositions for the show, Donovan tracked down the rights to "alien theme" pop music from the past few decades. The soundtrack made use of clips from such classics as Sheb Wooley's *The Purple People Eater*, The B-52's *Planet Claire*, Tommy James' *I Think We're Alone Now*, the Moody Blues' *I Know You're Out There Somewhere*, as well as themes from *The X-Files*, *The Day the Earth Stood Still*, *The Thing* and *My Favorite Martian*.

This was the first time we employed a soundtrack made largely of "needle-drop" music, as this was the first time we had the budget to pay for it. The result was a sound-track that has become an attraction on its own, generating lots of positive comments from the audience. People liked hearing music they knew. Music carries a lot of emotional baggage, and this show took advantage of that. We all feel it was the best sound-track we've run in a long time.

But—chasing down the sync and mastering rights to all the music was an enormous task we likely would not take on again for that many selections. It can take weeks of hunting to find the right person in the music biz chain of command with the authority to grant you the rights you need for just one piece, let alone a dozen. Hiring more people to do the job would not have helped—you simply can't find the person you need or get a firm commitment and price quote from anyone you do locate.

#### What Did We Learn?

After the steep learning curve of *The Quest for Origins*, our latest production went much more smoothly, despite a few snags encountered along the way (such as continuing technical incompatibilities between Mac and Windows QuickTime files).

Nevertheless, installing the show in our theatres went well and the end result looked and sounded great in our domes.

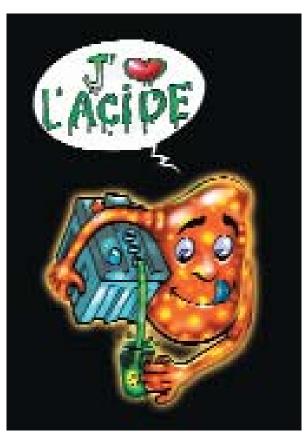
If we were to do it all again for a show as complex as Is Anybody Out There, we would want to employ additional staff or contracted expertise to handle more of the production research and co-ordination. Even so, we feel by pooling the in-house resources we already have we can carry off a show production of excellent quality for much less than the cost of hiring an outside production company to do it all. Costs for immersive video shows for the new projection technologies will be high, and getting good shows for an affordable price will be critical. Unlike institutional IMAX theatres, which have no production expertise on staff and have to pay high prices for independent film companies to produce suitable shows, planetariums are populated with skilled and talented production staff. But we need to learn from each other to develop the skills required by the new medium of immersive video.

#### **Learning From Each Other**

The two joint projects we've done to date, though conventional video and slide shows, began that process. Working together has taught us all a lot about new techniques and programming styles. Working with colleagues from the planetarium field, as opposed to independent writers or production companies whose main experience is with TV and film, creates opportunities to learn how to use our theatre differently.

For example, when the show premiered in Montréal, comments of "that's the best planetarium show I've seen in years" were heard in conversations all over the office. Having a host appear on video was never done before in Montréal. It was a shock to audiences at first, but most of the regular patrons got used to it. The technique will certainly become a new tradition, replacing the conventional voice-over where possible.

In Winnipeg, people also liked the use of a visible host, despite the fact the technique works less well in a theatre with concentric seating. But overall, audiences found the show to be fast-paced, smart and with interesting topics. As a result, attendance in Winnipeg was above projections for the first



The potentially technical and jargon-laden subject of extremophile life was dealt with by creating cartoons of lovable extreme-loving cellular creatures, like this acidophile who also happens to speak French.

time in years, keeping the parent museum happy.

In our case, a consortium worked because each of our four facilities had, over the years, independently developed expertise in a key area of show production. This was done without any form of coordination, almost by chance. But the result was an almost perfect blend of skills among the four facilities. Working well together will become increasingly important as more planetariums look for high-quality productions.

A production consortium is a practical and affordable method for the creation of content for all planetariums, especially new digital theatres with their need for many animators and new media artists. A consortium is one answer to the legitimate concern of managers considering upgrading their theatres: can we afford the shows? While our money-raising experience may be uniquely Canadian, the process of establishing a production consortium to address the need for affordable show content is not.

In the end we like the dynamics and trust we've established among our facilities after two productions. But the bottom line is money, and money comes to us easiest if we act as a group and distribute the production process.

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## Justification of a Planetarium

#### Torvald Hessel, Director Friends of the Austin Planetarium 9517 Old McNeil Road Austin, Texas 78758 USA

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Austin, Texas USA has a population of about 670,000 and currently is the largest city in the United States without a planetarium. In 2003 the Friends of the Austin Planetarium (FOTAP) was formed with the goal of building a first class planetarium in Austin. Several previous attempts to build a planetarium in the city had all ended in failure.

The fact that Austin does not have a planetarium is very surprising because it is home of the University of Texas at Austin, famous for its world-renowned astronomy program and the McDonald Observatory. It is often called the "silicon valley" of the south because Dell Computer, Advanced Micro Devices, IBM, Samsung, Applied Materials, and more all have large offices and factories here. Despite its highly technological workforce, Austin also does not have any science/astronomy related museum. (There is the Austin Children's Museum, but this facility is focused towards the pre-school level and is very limited in its science scope.)

#### The Need for Credibility

In its first two years, FOTAP's primary goal was to establish itself and create credibility with the public. One problem was (and still is) that people in the Austin area lack understanding about planetariums. A lot of people do not know what a planetarium is, and most have not visited one. In order to obtain their support for a planetarium or science center, influential administrators and educators must be informed and convinced of the substantial positive impacts such a facility would have for the community. To do this, hard data supporting our opinion that Austin was missing something crucial was needed.

To find these "hard data" we contacted and visited many planetariums, both nationally and internationally. Unfortunately, we found that the data are largely unavailable. This makes some sense; after a planetarium is established the discussion whether or not it is needed becomes academic. However, every planetarium professional should be able to sum up the key benefits of their facility with supporting figures. When budgets change, upgrades to existing equipment are

needed, and/or expansions are requested, you will have to justify your request—or even the existence of your planetarium. In our case, the data were not just nice to have—they were absolutely crucial to our success.

In order to convince elected officials and other key people, you must be well prepared. You will have to provide the facts *they* are looking for, not just the data that has your interest. Clearly, as planetarium professionals, it is our job to show a problem exists, that

a correlation to the use of planetariums, we can make that strong suggestion to support

FOTAP was chosen to participate in an undergraduate project by the McComb's School of Business at the University of Texas at Austin.¹ Four students researched the educational benefits of a planetarium. The discovered that several publications exist that address this issue, and four references stand out:



**Torvald Hessel** 

As planetarium professionals, we all know the benefits of a planetarium and see them on a daily basis: it inspires, educates, and brings culture to a city or region. However, these statements are unquantifiable and are not unique to a planetarium. An aquarium or zoo, for example, can make the exact same statements. So what exactly are the educational benefits of a planetarium? What does a planetarium add to a city that no other

facility can? This article addresses these issues, and provides several avenues to justify a planetarium.

it actually are the elected officials (if applicable) who have the problem, and you have the solution to this problem. Therefore, the data we were looking for had to address these key points.

#### **Highlighting Educational Benefits**

Standardized testing continues to gain in popularity and testing results are publicly available. For the US, a website like www.just4kids.org is a treasure-trove of information. Using this website, we were able to compare local school districts with school districts that have many planetariums in their vicinity. In our case we used the Dallas, Texas area schools, because there are 12 planetariums in the Dallas-Fort Worth area. As we had hoped, the test scores in earth sciences for fifth grade children were significantly better (>4%) than the Austin school district. Although this is not proof of

- A study of programs offered at the Houston Museum of Natural Science for Houston schools documented that, in association with a hands-on science lab, a planetarium program increased student understanding of related topics by 24% and resulted in an 11% increase in the students' interest in science as a career. (Sumners, 2000)<sup>2</sup>
- In a study of 471 sixth graders on planetary motion, a planetarium proved superior to classroom instruction in teaching students to use space-time relationships, infer planetary motion, recall astronomy information, and apply astronomy concepts. (Hayward, 1976)<sup>3</sup>
- In a worldwide survey of over 750 teachers who used a planetarium in their instruction, nearly 92% agreed that it helped make their students enthusiastic about science. Kratzer, 1997)<sup>4</sup>
  - Trips to a planetarium or science muse-

um are memorable. Over 80% of graduating college students recall specifics of trips they made to planetariums in the first, second, or third grade. (Rennie & McClafferty, 1995)<sup>5</sup>

The first bullet proved to be especially helpful with convincing politicians and university administrators of the need for a planetarium. To potentially improve science education with a double digit number is quite an achievement. The 11% increase in interest in science as a career potentially results in more students going to a university. Therefore, for university recruitment purposes a planetarium is very beneficial. Of course, many ways exist to shape and use this data depending on the person or institution you are trying to convince of your need for a planetarium.

#### **Gathering Your Own Hard Data**

Although we found some research detailing the benefit of a planetarium, the data are still limited. In our case, we were very fortunate that the Sumners study was local. This made for a stronger argument. Seek out local data first, and then move outward as necessary.

We also developed our own survey with strategically designed questions. The survey was aimed at third- to eighth-grade science teachers or classroom teachers who teach science as part of the curriculum. There were 13 questions and nearly all asked for responses on a Leikert scale (e.g., "You have enough resources within the community to support you in teaching astronomy or related topics: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). The survey was anonymous and used for statistical purposes to evaluate the demand for a planetarium and other science infrastructure (such as a museum) among the educators who would most likely use it. Because we already had endorsements from the highest representatives in the educational system, we had access to mailing lists and addresses. Consequently, we received more then 250 surveys back, creating a very significant argument from local educators. Some of the survey results are listed below:

- Less than half (46%) of all local educators surveyed felt that they had adequate resources and support for astronomy and space science instruction in the classroom to help them fulfill the science Texas Essential Knowledge & Skills (TEKS) requirements in this area.
- Two-thirds (66.7%) felt they did not have adequate resources and support for science instruction in the community (museums, laboratories, etc., where students could perform experiments) to help them fulfill the science TEKS requirements.
- Over 88% of the educators surveyed agreed that having a planetarium with addi-

tional labs for student hands-on experiments would enable them to perform their teaching responsibilities better or easier.

- Nearly 85% felt it is necessary to build a planetarium in Austin, and over 91% felt it is necessary to build a science museum.
- Fully 94.9% of the teachers surveyed felt that having hands-on science experiments, such as those available at the proposed planetarium and science museum, were "very valuable" for a

s t u d e n t ' s learning experience.

• Of the more than 200 educators surveyed, nearly 90% would "definitely" or "probably" take their students to the planetarium as part of their curriculum.

In addition to capturing

quantifiable data in this survey, we also gave science educators an opportunity to give comments. Some of these have proven very helpful. For example:

"It (a science museum) would promote interest in science for young people who never got exposed to scientific knowledge, especially for low socio-economically disadvantaged children. These kids need it the most. The chance of their families taking them to Ft. Worth or the Houston Science Museum is zero." (an elementary science teacher)

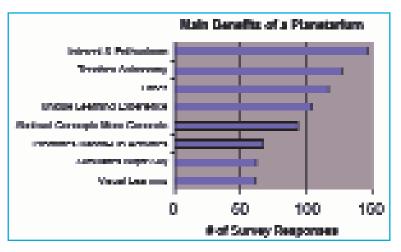
"[Student] TAKS (Texas Assessment of Knowledge and Skills) scores are just an indicator of what we have known all along. You have to provide meaningful, relevant experiences for students to develop the deep understanding needed to retain information from year to year. We do not have enough resources to do that!" (elementary science teacher)

"It is such a unique experience, the instruction and learning are unforgettable! I still remember going to a planetarium as an elementary school student where I grew up! And it instilled an interest in astronomy throughout my education." (first grade teacher)

#### A Successful Conclusion

We were able to present data to politicians and other elected officials that they can understand and remember. This was highly successful and culminated in the result that FOTAP now has four choices for a location to build a planetarium with a science museum. We have grown from a \$5 million project to a potentially \$60-80 million facility at a premier downtown location.

Even with all the data we have collected, we are sure that there is much more available. We hope the ideas and results described in this article give the reader some new ideas. All documents referenced in this article have been made available on www.AustinPlanetarium.org/IPS . You will be able to find the



complete McComb's School of Business study, the survey of science teachers, and marketing documents created using this data. Additionally, we have set up a discussion forum where you can post your comments and remarks, or post any data you would like to share with us and the IPS community.

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## Astronomy in the K-8 Core Curriculum: A Survey of State Requirements Nationwide

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In 1996, the National Research Council (NRC) published the National Science Core Standards (NRC 1996), a potential starting point for the development of state core curricula in the sciences. The implementation of these core standards has varied from state to state, both in content and in timing, with individual states making decisions about not only what should be covered in K-12 education but also when students are prepared to tackle specific scientific concepts.

This state-to-state variation makes preparation of curriculum materials difficult for large organizations hoping to have national impact. These organizations often fall back to the NRC core standards to determine the intersection of their materials with the content goals of teachers. However, how the individual state core standards compare with the NRC standards is unclear. To find out, we have compiled the astronomy standards for most of the nation, searching the published state science standards for astronomy content

We had several questions that wanted to answer:

• Are state core curricula similar to one

another with respect to astronomy content?

- Are the same topics being taught at the same level in most states?
- How similar are the core concepts to those recommended by the National Research Council?

equivalent (hereafter referred to generally as DoEd) between January 2006 and June 2006. We gathered data for 48 states and the District of Columbia (Iowa's standards are not published online, and Michigan's standards were undergoing revision). Shortly

We have compiled the K–8 core standards in astronomy for 48 states and the District of Columbia. Astronomy coverage in state curricula varies broadly from state to state, both in quantity and in content. Comparing these core standards between states and with the National Research Council (NRC) astronomy core standards gives interesting information for outreach professionals building curriculum materials for national distribution. Although the NRC standards provide a solid starting point for curriculum development, most states expand their astronomy coverage beyond the NRC topics.

## Gathering Data - State Core Standards

Data were gathered from the Web sites of individual state departments of education or

into the research, we decided to limit ourselves to grades K-8, leaving grades 9-12 for a later time.

In all cases, we assumed that the published online data from the states' DoEds were current. This may or may not be true, but because these standards often vary from year to year (consider the well-known case of Kansas), a "snapshot" of the state standards is probably the best one can do.

For the first 15 states, we kept a list of the topics covered and the grade level in which they were taught. This allowed us to build a matrix of topics versus state (see Table 1). Further states were added to this matrix.

Reprinted with permission from *Astronomy Education Review*, Issue 1, Volume 5:23-35, 2006 Received: 07/27/06, Revised: 08/01/06, Posted: 08/28/06

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The latest (eighth) issue of Astronomy Education Review, the web-based journal/magazine for everyone involved in astronomy education and outreach, can be found at http://aer.noao.edu. AER actively solicits interesting papers and articles on all aspects of space science education and outreach. AER is particularly interested in increasing the number of papers relating to education outside the formal classroom. The site gets between 150,000 and 200,000 hits per month from 91 different countries. Editors are Sidney Wolff and Andrew Fraknoi.

When necessary, new topic columns were added. In total, 45 astronomy topics of varying specificity are covered in grades K-8.

## Gathering Data - National Content Standards

The NRC standards are available online (http://newton.nap.edu/html/nses) or in book form (NRC 1996). These standards are conveniently grouped, varying from general science standards (e.g., critical thinking, mathematical reasoning) to specific content standards (e.g., "the Earth goes around the Sun"). We limited ourselves to content standards, which compare most easily with the state standards. The NRC standards are divided into K-4 and 5-8 grades. For the reader's convenience, we reproduce the astronomy content of these standards here:

#### Kindergarten - Grade 4

I) The Sun, Moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.

II) The Sun provides the light and heat necessary to maintain the temperature of the Farth.

III) Objects in the sky have patterns of movement. The Sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The Moon moves across the sky on a daily basis much like the Sun. The observable shape of the Moon changes from day to day in a cycle that lasts about a month.

#### Grade 4 - Grade 8

IV) The Earth is the third planet from the Sun in a system that includes the Moon, the Sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The Sun, an average star, is the central and largest body in the solar system.

V) Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, the phases of the Moon, and eclipses.

VI) Gravity is the force that keeps planets in orbit around the Sun and governs the rest of the motion in the solar system. Gravity alone holds us to the Earth's surface and explains the phenomena of the tides.

VII) The Sun is the major source of energy for phenomena on the Earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the Sun's energy hitting the surface due to the tilt of the Earth's rotation on its axis and the length of the day.

## Gathering Data- The AAAS Core Curriculum Benchmarks

Similarly, Project 2061 (a project of the

American Association for the Advancement of Science) has derived "benchmarks" for science literacy. In general, benchmarks are more detailed than standards and can be thought of as "drilling down" into the content to a more detailed level. Here, for convenience, we list the astronomy-related benchmarks (Project 2061 1993) and, where possible, identify them with an NRC content standard, in parentheses.

#### AAAS Kindergarten - Grade 2

There are more stars in the sky than anyone can easily count, but they are not scattered evenly, and they are not all the same in brightness or color. (I)

The Sun can be seen only in the daytime, but the Moon can be seen sometimes at night and sometimes during the day. The Sun, Moon, and stars all appear to move slowly across the sky. (III)

The Moon looks a little different every day but looks the same again about every four weeks. (III)

The Sun warms the land, air, and water. (II)

#### AAAS Grade 3 - Grade 8

The patterns of stars in the sky stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons. (III)

Telescopes magnify the appearance of some distant objects in the sky, including the Moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than can be seen by the unaided eye.

Planets change their positions against the background of stars (V, although not explicitly)

The Earth is one of several planets that orbit the Sun, and the Moon orbits the Earth.

Stars are like the Sun, some being smaller and some larger, but so far away that they look like points of light. (IV, implicitly, "The Sun, an average star...")

Like all planets and stars, the Earth is approximately spherical in shape. The rotation of the Earth on its axis every 24 hours produces the night-and-day cycle. To people on Earth, this turning of the planet makes it seem as though the Sun, Moon, planets and stars are orbiting the earth once a day. (V)

#### AAAS Grade 6 - Grade 8

The Sun is a medium-sized star located near the edge of a disk-shaped galaxy of stars, part of which can be seen as a glowing band of light that spans the sky on a very clear night. The universe contains many billions of galaxies, and each galaxy contains many billions of stars. To the naked eye, even the closest of these galaxies is no more than a dim, fuzzy spot.

The Sun is many thousands of times closer to the Earth than any other star. Light from the Sun takes a few minutes to reach the Earth, but light from the next nearest star takes a few years to arrive. The trip to that star would take the fastest rocket thousands of years. Some distant galaxies are so far away that their light takes several billion years to reach Earth. People on Earth, therefore, see them as they were that long ago in the past.

Nine planets of very different sizes, composition, and surface features move around the Sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity. The Earth is orbited by one moon, many artificial satellites, and debris. (IV)

Large numbers of chunks of rock orbit the Sun. Some of those that the Earth meets in its yearly orbit around the Sun glow and disintegrate from friction as they plunge through the atmosphere—and sometimes impact the ground. Other chunks of rocks mixed with ice have long off-center orbits that carry them close to the Sun, where the Sun's radiation (of light and particles) boils off frozen material from their surfaces and pushes it into a long, illuminated tail. (IV)

We live on a relatively small planet, the third from the Sun in the only system of planets definitely known to exist (although other similar systems may be discovered in the universe). (IV, although this benchmark obviously requires modification to accommodate the discovery of extrasolar planets.)

Everything on or anywhere near the Earth is pulled toward Earth's center by gravitational force. (VI)

Because the Earth turns daily on an axis that is tilted relative to the plane of the Earth's yearly orbit around the Sun, sunlight falls more intensely on different parts of Earth during the year. The difference in heating of Earth's surface produces the planet's seasons and weather patterns. (III or V)

The Moon's orbit around Earth once in about 28 days changes what part of the

(Please see **Requirements** on page 31)

Table 1 (on next five pages): Astronomy core standards across the nation. Each column contains the topic title and the grades in which it is taught for each state. For the readers' convenience, the total number of topics in each state is tabulated in the left-most row, and the number of states teaching each topic is tabulated in the bottom row.

Table is available in Excel format at: aer.noao.edu/cgi-bin/article.pl?id=204; links to state standards web sites also can be found with the article.

**Table 1.** Astronomy core standards across the nation. Each column contains the topic title and the grades in which it is taught for convenience, the total number of topics in each state is tabulated in the left-most row, whereas the number of states teaching each row. The Web sites from which this information was obtained are given in the appendix.

						_		
			Forth and				Cun maan atara	
# topics in		Objects in	Earth and moon are			Sun "moves"	Sun,moon,stars, appear to move	Earth's tilt/
this state	State	sky	round	Rotation	Revolution	in sky	East to West	seasons
26	Alabama	K1	Tourid	rtotation	3	iii oity	4	3,5
13	Alaska	3,4,5		5	5	5	5	5
21	Arizona	1		5	5	1	5	7
20	Arkansas	1		2,3	2,3	K		48
14	California					3		3
18	Colorado	K4				K4	58	K4
11	Connecticut			5	5	1		
24	Delaware	K3	K3	K3	K3	K3	45	68
16	Florida	35	K2	K2	K2	K2		35
25	Georgia	K		4	4	2	_	4,6
17	Hawaii	K		4	4	2	2	8
16	Idaho	17.0		3	3	3	3	3
25 19	Illinois	K-3	E	K-3	K-3	K-3	K-3	46
18	Indiana Kansas	3 K-2	5	3,4	3	3	3	6 57
15		K4				3	K4	57 K8
24	Kentucky Louisiana	K4 K,2		35	3,5	3	5	4,8
16	Maine	N,Z		34	5,5 K4	3	K2	58
7	Maryland	K		34	114	2	2	30
18	Massachusetts	11		35	35	35	35	68
24	Minnesota	1		3	3		4	3,8
27	Mississippi	K	K	5	5			5,6,7
38	Missouri	K-2	K-2	K2	K2	K-2	K-2	34,58
26	Montana	K4	K4	K4	K4	K4	K4	58
20	Nebraska	K1	K1	24	24	K1	24	58
24	Nevada	K2	K2	35	35	K2	K-5	35
19	New Hampshire	K6	K6	K6	K6	K6	K6	K6
19	New Jersey	K2	K4	K4	K4	K4	K4	58
32	New Mexico	K,2	K			K,1	1	5,6
20	New York			K8	K8	K4	K8	58
20	North Carolina	0.0	_	6	6		3	6
18	North Dakota	2,6	5				14.0	8
12	Ohio					4.0	K2	68 7
13 21	Oklahoma	K8	4	4,5	4,5	12	2,4	68
23	Oregon Pennsylvania	N0	4	57	4,5 K7		2,4 57	K4
22	Rhode Island	K2	35	35	35		K5	68
22	South Carolina	1,4	JJ	8	8	1	1	4,8
24	South Dakota	1,4		4	3,4	,	'	3,8
23	Tennessee	K3		5	5	K3	4	6
14	Texas				-			7
13	Utah		3	3	3	3		6
14	Vermont				K4			58
20	Virginia			1,4,6	6		4	4,6
13	Washington	35				K-2	35	
18	West Virginia	K1		2	3		1	2,68
18	Wisconsin	K4		58	58	K4	K4	K4,58
11	Wyoming	K4		58	58			K4
16	District of Columbia	3		5	5	3	3	5
	number of states	35	15	36	38	32	37	46

Alabama	Earth-Sun distances/s olstice		Moon phases	Solar/lunar eclipse 7	Moon/- tides 5,7	Earth's position in solar system 3	Star map/const- ellations 3,8	North Star	Culture related to objects in night sky	Gravitational attraction/- orbit/- Newton's laws 3,5,7
Alaska										
Arizona		7	5	7	7	7	7			5
Arkansas		6	4		•	5	·			8
California		3	3			Ŭ	3			5
Colorado	58	K4	58	58	58	58	- U			Ŭ
Connecticut	0 0	8	5	0 0	0 0	0 0				8
Delaware		45	68	68	68	68	45			68
Florida		35	35	00	00	00	45			00
			4,6				2		2	6
Georgia		4				_				0
Hawaii		8	3	0		5	2,3			0
Idaho	7.0	3	8	3	7.0	8	4.0			8
Illinois	7,8	K3	46		7,8	7,8	46			7,8
Indiana		3	3,6			6	5			
Kansas		57	57	57	57	57				
Kentucky		57	K8	57	57	57				57
Louisiana	8	4	4	4,8	8	5		5		8
Maine		K4	34		34		58			
Maryland			2							
Massachusetts	68	35	35,68	68	68	35				68
Minnesota		3,8	8	8	8	8	4			8
Mississippi	7	4,7,8	2,5,6,7	6,7	5	4	3,4			
Missouri	58	K2,58	34,58	34,58	58	34,58	38		3,4	58
Montana	58	58	58	58		58	58		σ, .	58
Nebraska	58	28	24,58	58	58	58	- 0 0			58
Nevada	0 0	35	K2;68	0 0	0 0	68	35			68
New Hampshire		K6	K6	710		710	K6			0-0
New Jersey	58	K8	58	58	58	K4	110			
New Mexico	6	6	1,2,6	6	6	3,7	3,4			8
	0					3,7	3,4			
New York		58	K8	58	58	0				58
North Carolina		3	3,6	6	6	6				
North Dakota		5,8	8	8	8					
Ohio		38	68	68	68	35				68
Oklahoma		5,7	7	7		5,7				
Oregon		K8	2,68			K8				3,68
Pennsylvania		K4	K4	K4		K4	57			57
Rhode Island		35	K2;68				K5			38
South Carolina		1,4,8	1,4,8	8	8		4			8
South Dakota		4,6,8	3,4,8	8	8	3	4,5,8			8
Tennessee		4,6	K5	4,6	6					5,6
Texas		5	7							5
Utah		3	3,6						6	
Vermont		K4								58
Virginia		4,8	3,6	K-8	4,6	6				6
Washington		68	35		,-	68	35			
West Virginia		3,4,6,8	23,6	8	68		4			
Wisconsin		58	K4	J	J 0	K4	7			58
Wyoming		58	11			58				58
		J0				J0				J0
District of Columbia			3			5	5			8
									_	
number of states	10	46	46	28	25	33	23	1	3	32

	VS.	Time from sky/time zones reasoning (Big Dipper	Sun		Asteroids, comets, meteoroids, meteors,	Earth- asteroid	Moon	Planets/- solar	(including
A I = I =	heliocentric)	clock/sundial)	Properties	Aurora	meteorites	history	Properties	system	Earth)
Alabama			4,7		4,8		4,7	24	67
Alaska			4		5			5	6,7
Arizona			7		5		7	5	5,7
Arkansas			6				56	3	4,6
California			3,5,8		8		3,8	5	8
Colorado			K4				K8	K8	58
Connecticut			8				8	5	8
Delaware			48				45	68	68
Florida			35				35	35	68
Georgia			2,4		6		4,6	4	
Hawaii			5,8				8	5	8
Idaho			3				3,8	4	8
Illinois			K3,7,8		7,8		K3,7,8	46	7,8
Indiana			3		8		3,4	6	6
Kansas			57		57		57	57	57
Kentucky			K7		57	57	57	57	57
Louisiana			2,4,5		5	0 1	4,5	3	5,8
Maine			K4		58		34	38	0,0
Maryland			2		30		2	30	
Massachusetts			35				38	35	68
			3,8						3,8
Minnesota							3,8	3	
Mississippi			2,4,7,8				4,8	2	4,8
Missouri		34	K-2		58		K-2	34,58	
Montana			K8				58	58	58
Nebraska			K4				K4	58	58
Nevada			35				35	35	68
New Hampshire		110	K6				K8	710	710
New Jersey			K8				K8	K4	58
New Mexico			K,1,2,6,7		6		1,6	3	3,6
New York			58		58		58	58	58
North Carolina	6		3,6	6	6		3		6
North Dakota	-		5,6,8		6		5,8	4,6	5,8
Ohio			68				68	-,-	68
Oklahoma			5,7		7		5,7	5,7	7
Oregon			68		68		K8	58	68
Pennsylvania	58		K4		57		K4	K7	58
Rhode Island	30	35	38		68		35	35	68
South Carolina	4,8	J- <b>-</b> J	1,4,8	8	4,8		4	4,8	8
South Dakota	4,0		4,6,8	0	6,8		4,6,8	2,46,8	4,5,8
	6							Z,46,8 K4	
Tennessee	Ö		4,6		4,6		4,6		5,6
Texas			3,5		6		5	3,6	5
Utah			3				3	6	
Vermont	58		K8				K4	K8	58
Virginia			1,4,8		6		4,8	6	6,8
Washington			68		68		68	68	68
West Virginia			3,4,6,8				3,4,6,8	3;4,7	68
Wisconsin			58				58		58
Wyoming			58		58		58	58	
District of									
Columbia			8				5	5	8
number of states	5	3	48	2	27	1	48	45	44

			Solar system location	Origin and evolution of universe	Organization	Universe motion/- expansion/-	Radiating vs	Space exploration/-telescopes/-	Technology resulting from space
	Deep sky objects	Galaxies	within galaxy	and solar system	of known universe	Doppler effect	Reflecting bodies	live in space?	exploration- history
Alabama	5,8	5,8	уагалу	System	universe	enect	bodies	8 8	35,8
Alaska	3,0	3,0						O	35,6
Arizona					7	7		5	
Arkansas		8	8	8	,	,		Ŭ	58
California		8		Ŭ					0 0
Colorado				58				K4	
Connecticut						5			
Delaware		68	68			-			
Florida		68			68				
Georgia		6	6	6	6				6
Hawaii		8			8			5	-
Idaho				8	8				
Illinois		7,8	7,8			46			
Indiana			,		7				
Kansas								57	
Kentucky									
Louisiana								4,5,8	8
Maine		58						, ,	
Maryland									
Massachusetts		68			68				
Minnesota		8	8	8	8			4	
Mississippi		8	8	8	8	7	7	4	
Missouri	8		58		58	58		58,	34,58
Montana			58	58		58		58,	58
Nebraska							24	·	
Nevada		68	68		68				
New Hampshire									
New Jersey								58,	58
New Mexico	6	5,6	5,6		5,6	8	8	3,4,5	
New York			K8	K-8					
North Carolina			6	6	6				6
North Dakota	8	8			8				
Ohio								68	
Oklahoma									
Oregon			68		68			4,68	
Pennsylvania				58	8			58,	
Rhode Island			68		68			35	68
South Carolina									4
South Dakota		8		6		8		_	_
Tennessee		6						6	6
Texas		8		8	8				6
Utah						6			
Vermont	14.5	58		58					58
Virginia	K-8	K-8							6
Washington								7.0	
West Virginia		8						7,8	
Wisconsin		58			58				
Wyoming									
District of Columbia									
number of states	5	22	14	13	19	9	3	18	14

	Current technology/ careers	Types of data collecting telescopes and how they are used (x- ray, infra)	Evidence for big bang - cosmic background, red shift	Star cycle/- properties	H-R Diagram	Fusion as stellar energy source	Distance of stars/-brightness	Spec- troscopy of stars (elements)	Distances in space	Light year
Alabama		5,8	8	8	8		4		8	Ŭ,
Alaska		•					8		7	6
Arizona										
Arkansas	58		8	58						
California								8	8	
Colorado	58								58	
Connecticut										
Delaware	45					68	68	68		
Florida		68		68						
Georgia	4,6	4,6	6	4			4		6	
Hawaii	,	,								
Idaho										
Illinois				7,8	7,8	7,8			7,8	
Indiana				5,7	7				,	
Kansas	57			57	57					
Kentucky	_			_						
Louisiana				8	8				8	
Maine				58	58				58	
Maryland				2						
Massachusetts				_						
Minnesota				4,8	8	8				
Mississippi				3,8		7	4			8
Missouri	58	58	58	58	58	58	58	58	58	58
Montana	58	58	0 0	0 0	0 0	K4	0 0	0 0	0 0	0 0
Nebraska	0 0	0 0				58				
Nevada					68	35	35	35	68	
New Hampshire			710		0 0	0 0	0 0	K8	0 0	
New Jersey			, 10							
New Mexico				6	6	6	2,8	6,8	5,8	8
New York			K8			K8	2,0	0,0	58	J
North Carolina	6		11 0			1. 0			0 0	
North Dakota				8	8	2				
Ohio				- ŭ						
Oklahoma						1,6				
Oregon	68			3,4		1,0			68	
Pennsylvania	, ,		8	58	8		8		5 0	
Rhode Island			j	35						68
South Carolina	4					8				
South Dakota	,		8	8	8			8	8	
Tennessee	6	K4	J		<u> </u>				6	
Texas									8	
Utah									6	
Vermont			58	58						
Virginia			K-8	K-8						
Washington				1, 5					68	
West Virginia	8			7					5 5	
Wisconsin	58	58		58						
Wyoming	0 -0	J -0		0 -0						
District of										
Columbia				8	8					
number of states	13	7	10	24	14	13	9	7	18	5

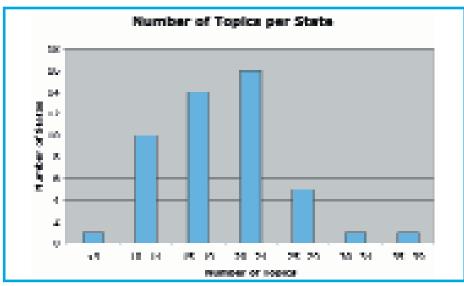


Figure 1. The number of states with a given number of topics in their core curriculum. The average number is 19, the maximum is 38, and the minimum is 7. Graphic by authors.

N	Topics
N>=45	Earth's orbital properties; Sun properties; Moon properties; Earth tilt/seasons; Moon phases; planets/solar system
40<=N<=44	Inner/outer planet characteristics
35<=N<=39	Sun, Moon, stars appear to move east to west; objects in the sky; rotation; revolution
30<=N<=34	Sun "moves in the sky; Earth's position in the solar system; gravitational attraction/Newton's laws
25<=N<=29	Solar/lunar eclipse; Moon/tides; asteroids/comets/meteors
20<=N<=24	Star cycle/properties; star maps/constellations; galaxies
15<=N<=19	Organization of known universe; Earth/Moon are round; distances in space; space exploration/telescopes/live in space
10<=N<=14	Solar system location in galaxy; H-R diagram; fusion/stellar energy source; Earth/Sun distance/solstice; origin and evolution of universe and solar system; technology from space exploration; current technology/careers; evidence for Big Bang
5<=N<=9	Distance of stars/brightness; spectroscopy of stars/elements; universe motion/expansion/Doppler effect; types of telescopes (X-ray, IR); history of astronomy/geocentric versus heliocentric models; light year; deep sky objects
N<=4	North star; culture related to objects in the night sky; aurorae; Earth- asteroid history; time from sky/Big Dipper clock; radiating/reflecting bodies

Note: N, in the first column, is the number of states teaching the topics listed in the second column. Bolded topics are those that are similar to the topics in the NRC core curriculum.

(**Requirements**, continued from page 25)

Moon is lighted by the Sun and how much of that part can be seen from Earth—the phases of the Moon. (V)

The Sun's gravitational pull holds Earth and other planets in their orbits, just as the planet's gravitational pull keeps their moons in orbits around them. (VI)

In this study, we concentrate on comparing the state core standards with the NRC core standards for three reasons. First, nearly all states had published curricula at the core standard level of detail. Second, although benchmarks exist in most states, the level of detail involved makes a comparison between different sets of curricula prohibitively difficult. Third, the NRC core standards and the AAAS benchmarks are quite congruent, with only 3 of the 19 benchmarks not covered in the NRC core standards. The exceptions can be summarized as covering telescopes, the size of the universe, and the structure of the universe.

#### Generalizing the States' Results

The number of astronomy standards taught in a given state varies from a low of 7 in Maryland to a high of 38 in Missouri. The average number is 19. Figure 1 shows the distribution of the number of topics taught. The popularity of topics is given in Table 2. The six most popular topics are taught in more than 45 states. These topics are probably not a surprise, covering primarily the Earth-Moon-Sun system and the solar system.

A geographical comparison of the number of astronomy topics per state (see Figure 2) shows no correlation with political (i.e., "redblue") maps. This may indicate that the local politics of the electorate has little influence on the amount of astronomy taught in a given state. Nor is there an obvious correlation with latitude, population density, good observing weather, or dark skies.

## Comparing the NRC and the States' Results

We compared the states' content standards with the wording of the NRC standards and concluded that 15 of the 45 topics covered in the states were part of the NRC core. This is a bit subjective because the wording varies greatly from state to state. Table 3 summarizes these data. The age at which the topics are taught agrees with the recommendations of the NRC. In addition, most of these 15 topics are among the 15 most commonly taught, suggesting that most states include most of the NRC standards and add to them to build their individualized core standards.

Two topics from the NRC core standards are rare in the state standards: the connec-

tion between the Moon and tides, and properties of stars. Although gravitational attraction (as the cause for orbital motions) is taught in 32 states, the relationship between the Moon and the tides (gravity as the sole explanation for tides) is taught in only 25 states. A study of the properties of stars (which we consider implicit in the statement that the Sun is an average star) is covered in only half the states, although it could be argued that 32 states cover some kind of stellar astronomy topic (star cycle/properties, H-R diagram, fusion, or spectroscopy).

Curriculum developers are wise in using the NRC standards as a jumping-off point for curriculum development. However, it must be noted that none of the topics is covered in all states, and only seven are covered in more than 80% of states.

Most of these topics, both in the state curricula and the NRC core, are focused on Keplerian astronomy-orbital motions of the Earth and Moon and their consequences. It could be argued that a focus on this phenomenological level detracts from a deeper conceptual understanding for students. One must be careful about drawing too strong a conclusion from this, however, because we have limited this study to the core content standards; we are examining only the "facts." More general goals, such as developing conceptual understanding or critical thinking, may be embedded further down the curriculum chain—at the benchmark level, or at the level of texts or activities.

## Contrasting the NRC and the States' Standards

As expected from the pure numbers of topics, the states' standards are more general than the NRC standards and cover a broader range of topics.

None of the NRC standards includes modern astronomical content. The states have attempted to include more recent advances. From stellar astronomy (taught in various incarnations in 32 states) to galaxies (22 states) to the origin of the solar system (13 states), modern astronomy is making inroads into the K-8 educational system. Only 19 (42%) of the 45 aggregate state standards are Keplerian astronomy. A further 7 (16%) are solar system topics (which, of course can be quite modern!). This leaves 19 (42%) of the topics to cover the rest of the universe. But the raw numbers do not quite tell us what we want to know. Instead, we consider the weighted percentage, which tells us how commonly a particular field of study is taught. For the Keplerian topics, for example:

W(%) = (sum of all states teaching Keplerian topics)/(sum of all states teaching all topics) where the sum of all states teaching all topics is 946.

Using this metric, the standards are 52% Keplerian, 23% solar system, and 25% universe. Without making any judgments about the depth or value of a particular topic, we note that the astronomy learned by students nationwide is heavily weighted toward orbital mechanics of the Earth-Moon-Sun system.

#### Conclusion

The primary take-away message of this study is that the NRC science standards in astronomy are a great starting place for curriculum developers who wish to address at least some of the topics that are covered in every state. Most teachers, however, are required to teach several topics in addition to, or instead of, these topics. We suspect that these are likely to be the topics with which the teachers themselves struggle most and therefore deserve a focused effort by groups developing curriculum tools for K-8 teachers.

Secondarily, the K-8 curriculum is dominated by Keplerian astronomy. The relative importance of Keplerian versus modern astronomy is a matter for debate among the community at the college introductory level (see a review of the discussion by Jay Pasachoff 2002). Perhaps this debate needs to be extended to the precollege level as well.

Future work involves extending this study to grades 9-12, which is a bit of a challenge. High school courses tend to be topical—students are learning the "big three" of science: biolo-

gy, chemistry, and physics—and Earth and space sciences are often not part of the statewide curriculum. In addition, the deviation between students becomes much wider at this late period in their schooling; honors or college-bound students study a very dif-

**Table 3**. The 15 topics that are similar to those in the NRC core. These topics are listed in order of their frequency among states. The average grade in which they are taught compares directly with the NRC suggetions.

		1	
Topic	Number of states	Average Grade	NRC Suggestions
Sun properties	48	5	5-8
Moon properties	48	5	K-4, 5-8
Earth's tilt/seasons	46	6	5-8
Moon phases	46	5	K-4, 5-8
Planets	45	5	5-8
Inner/outer planet characteristics	44	7	5-8
Revolution	38	4	K-4, 5-8
Sun, Moon, stars appear to move east to west	37	3	K-4
Rotation	36	4	K-4, 5-8
Objects in the sky	35	2	K-4
Earth's position in the solar system	33	5	5-8
Gravitational attraction/Newton' s laws	32	7	5-8
Sun "moves" in sky	32	2	K-4
Eclipses	28	6	5-8
Moon/tides	25	7	5-8

ferent curriculum than other students.

It would be interesting to know what professional astronomers think are the most important topics for K-8 students. Several studies related to Astronomy 101 have been undertaken (Brissenden et al. 1999; Partridge

& Greenstein 2002), but the question of what students should know in K-8 has not been explicitly addressed.

Finally, it is unclear how the core curriculum standards translate into the actual learning experience of students in individual classrooms in each state. Having a topic in the core does not mean that it is being taught in the classroom. Assessment of whether the core is being learned most often occurs in the form of standardized tests administered to students at intervals. Particularly in this era of "no child left behind," this type of assessment functions as a stick for teachers: Teach the concepts or else. We would like to know what the carrot looks like: how are teachers being encouraged to include these topics in their classrooms and to seek innovative and interesting ways to teach them?

#### References

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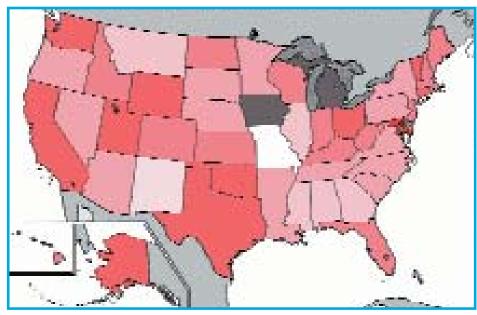


Figure 2. The number of astronomy topics taught in each state. Lighter red means more astronomy, while darker red means less astronomy. This map shows no correlation between political affiliation and amount of astronomy content, or any geographic correlation. Each state seems to go its own way, with no regard for the weather outside. Graphic by the authors

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## The "Planet" Decision

Martin George, Curator Launceston Planetarium Queen Victoria Museum Wellington Street Launceston, Tasmania Australia martin@qvmag.tas.gov.au

It was the decision of the year, as far as astronomy goes. It certainly generated quite a reaction around the world, with a good number of "Pluto supporters" complaining about it. But the International Astronomical

Union's decision on the definition of what makes a "planet," however, was a long time coming and needed to be done.

The atmosphere was rather tense on that Thursday afternoon, 2006 August 24, at the 26th General Assembly in Prague, as a large gathering of IAU members

sat in the Chamber Hall of the Prague Conference Centre. Television cameras were rolling, and reporters were chasing people for interviews both before and after the vote.

At the appropriate moment, the motion to accept the resolution was put to the membership and, with hands raised showing hundreds of yellow voting cards, Pluto's fate was sealed. The IAU finally had a definition of "planet."

Pluto's Been a Problem

We are, of course, all aware of the problem that has faced astronomers for some time now. Pluto was classified as a planet after its discovery in 1930 but, in those early years, little was known about it. Textbooks, even as recently as the 1960s, quoted Pluto's estimated diameter as up to half that of Earth's.

We now know quite differently. With the discovery of Pluto's largest moon, Charon, in 1977, it became quickly clear that Pluto's mass was well under one per cent that of Earth's. Subsequent occultation observations, especially, have pinned down Pluto's diameter to be about 2300 kilometres. Even more significantly, since the early 1990s astronomers have discovered many more Pluto-type objects orbiting beyond Neptune,

including several that rival Pluto in diameter and even one that exceeds it. It became clear that Pluto was merely one of the largest of a large group of similar objects.

The very fact that Pluto had long been

... the International Astronomical Union's decision on the definition of what makes a "planet," however, was a long time coming and needed to be done.

classified as a planet was initially in its favour. Even as recent as the first week of the IAU General Assembly, the proposed planet definition retained Pluto as a planet. Many people felt, however, that this was to a large extent based on an emotional attachment to Pluto rather than proper science.

There were three preliminary discussion sessions before the vote. Many people were very vocal about the situation, and at one point a member of the Planet Definition Committee was applauded for giving up her chance to speak in order to give the general membership more time to have its say.

The overriding physical principles used in the definition are: a planet must be in orbit

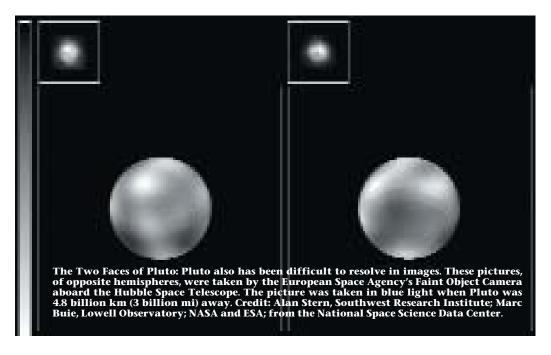
> around the Sun; it must be in hydrostatic equilibrium; and it has cleared the neighbourhood around its orbit.

Let's take these in turn.

#### A Planet Orbits the Sun

"In orbit around the Sun" is quite clear. If the body is a satellite of a planet—even if, like some large satellites, they would be considered to be planets in their own right if they were in an independent orbit—they are not considered to be planets. What I found a little disappointing here is that "the Sun" was used instead of "a star." The entire definition applies only to our solar system. I'll return to that point

"Hydrostatic equilibrium" basically means that the object has enough self-gravity to



overcome "rigid body forces"—that is, it is spherical, or nearly spherical. Of course, planets do exhibit oblateness due to their rotation, with Saturn the prime example. When questioned about this, Richard Binzel replied that the definition would be "applied intelligently." A sensible answer, with which nobody would argue.

#### Clears the Neighborhood?

The other criterion, relating to clearing the neighbourhood around its orbit, seems rather less well-defined. The meaning here is that the body is massive enough to have a strong influence in its region. At one point amongst the several drafts of the resolution, the words that were used were "dominant object in its local population zone." Although this is no longer part of the definition, it is a quite descriptive one and may have been

better left in. Even so, I still did not feel that the "dominant object" concept was sufficiently clear, and wrote to the Planet Definition Committee suggesting that this be better defined. It was after this that they came up with the neighbourhood-clearing concept.

An example of an objection to the neighbourhood-clearing concept is that Jupiter

has certainly not cleared its orbit, as it is well known that the Trojan asteroids exist at the L4 and L5 points, 60 degrees ahead and behind Jupiter. With any object, however, these points of gravitational stability exist, and if we were to exclude planets on that basis, we would have very few planets.

Another argument that has been put forward against the

"clearing the neighbourhood" idea is that under this definition, Neptune could possibly not be considered a planet, as Pluto's orbit crosses it. That is true, but Pluto is not by any means in the same or a similar orbit to that of Neptune. Its orbit is in a 3:2 resonance with Neptune, as is obvious simply by examining a table showing their orbital periods

Again, I think we should apply this criterion "intelligently."

#### "Dwarf Planet" Defined

The resolution also includes another definition. An object that has not cleared the neighbourhood around its orbit is called a "dwarf planet." This term now applies to Pluto, Ceres, 2003 UB313 (now named Eris),

IAU members hold up their voting cards to define "planet." It was at this moment that Pluto ceased to be classified as a planet. Photo by Martin George

and indeed it will apply to other objects, once their "roundness" has been established. Although at this stage we do not have proof that 2003 UB313 is round, it is a reasonable assumption, based on its calculated diameter.

All other objects are now to be referred to collectively as "Small Solar System Bodies." but the words "comet," "asteroid," and so on, can still be used.

Whatever the arguments about the char-

However, the failed resolution means that currently, there is no name for this (new) class of objects, and the IAU will now need to work to come up with a name.

acteristics that are used to define the meaning of "planet," there is an important footnote to the resolution. The footnote simply states "The eight planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune." It can't be more straightforward than that, and indeed, one speaker commented light-heartedly that perhaps the definition should just be the footnote and nothing else at all. This raised quite a number of laughs from the assembly—and even a short applause from a few!

Soon after the resolution was passed, a resolution to insert the word "classical" before the word "planets" in the footnote was defeated.

The next resolution was to recognise that, as a dwarf planet, Pluto is one of a new class

of objects—that is, objects beyond Neptune that are clearly different from asteroids, although that wording was not included in the definition. This resolution was passed, but a subsequent resolution to describe this class of objects—i.e. dwarf planets beyond Neptune—as "plutonian objects" narrowly failed to gain acceptance. I had argued at an earlier meeting strongly in favour of this after it had been suggested by another IAU

member. However, the failed resolution means that currently, there is no name for this class of objects, and the IAU will now need to work to come up with a name.

#### **Definition Is a Bit Narrow**

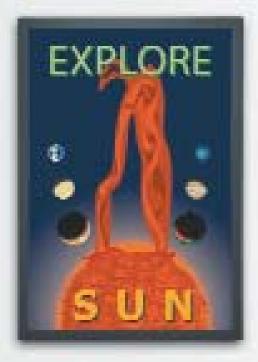
Back to the issue of the definition applying only to our solar system: I felt quite strongly that it should not. After all, we are

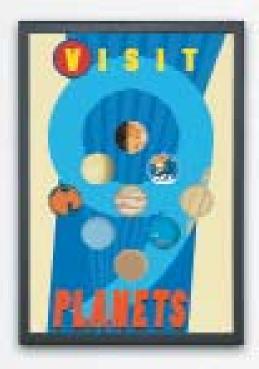
quite freely using the term "planet" when describing extrasolar planets, and I think that by excluding planets around other stars from the definition, the IAU is still somewhat behind the times.

I therefore wrote to the Planet Definition Committee with my concerns, but there was no resulting change in the proposed definition. The Committee, including IAU President Ron Ekers, was quite adamant that the definition should not apply to stars other than our Sun, and that is the way it remained.

As a result of this, there is no IAU definition of a planet around another star. I hope that this will change when the IAU meets again in Brazil in 2009, if not before.







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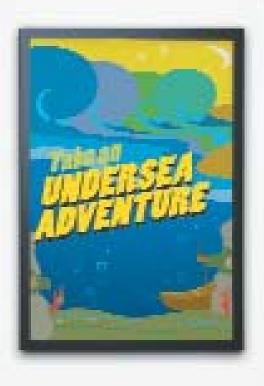
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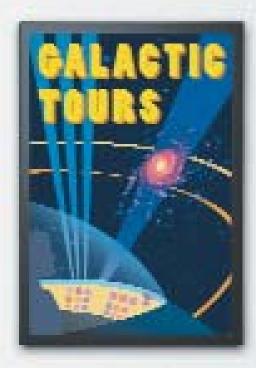
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## Chinese Student, Swedish University, Research in Germany:

## Report from Armand Spitz Scholarship Recipient

## Lars Broman Dalarna University SE 791 88 Falun, Sweden

Since 2004, students at Dalarna University in Sweden who study in the master's program in Science Communication have been awarded scholarships from IPS' Armand Spitz Fund for Planetarium Education. To be eligible for a scholarship, the student should do fieldwork in a planetarium and write a thesis on a subject related to planetariums. Two scholarships have been awarded annually, and reports from pre-

vious scholarship studies have been published in the *Planetarian* (December 2004 and December 2006).

This year, one scholarship has been awarded so far, to Yang Yu from China. A second scholarship was awarded in November. The IPS Council has graciously decided to continue the awards and give two more scholarships in 2007. Here follows Yu's account of his project.

# Exploring New Possibilities of New Generation Planetariums: Qualitative and Quantitative Study in Mediendom, Kiel, Germany

by Yang Yu

#### Reason, Aim, and Process

Currently, both old and new planetariums are facing one common issue: how to deal with the fast pace of change in technology while satisfying their audiences and providing education. On the one hand, refreshing technologies seem to be emerging continuously; on the other hand, some new concepts, such as "interdisciplinary combination," and "digital theater" are thought to be potential future routes, but many of these ideas are still only on paper or in the experimental phase for them.

During my practice and fieldwork time at Mediendom, I got the chance to witness, experience, and comprehend some practical applications of new performance models that combine avant-courier conceptions, upto-date and refreshing technologies, artistry, and public educational in one.

Meanwhile, I tried to identify the facility's success and insufficiencies or hidden troubles in order to supply more experiences for both new generation and upgrading planetariums. One important goal for me is to analyze collected data from my investigation and to orient the development trend of futures planetariums.

In the internship period in Mediendom, I got the opportunities to do both internal data analysis work and planetarium development trend studies. Methods that have been

used in my research include questionnaires, interviews, and internal data analysis.

Firstly, I scheduled my whole research plan. From the beginning of May until mid-July was data collecting time, when I arranged for questionnaires. The second half of July was for key personnel interviews and professional person interviews (director and producer of Mediendom, and one university Art lecturer).

Questionnaires were divided into three groups according to different backgrounds and motivations: a T-group (teaching staffs), P-group (public show visitors), and C-group (local planetarium club members). Starting in mid-July, I focused on both internal data analysis and collected data summation; actually, these two works supplemented each other very well. I completed my last stage of internship and research work in Mediendom in mid-August.

From my studies, some major issues have emerged, as has a trend in the development of new generation planetariums. I will continue to analyze these results and finish my thesis

## Development trend and features investigation:

From Singleness to multiplicity: Questionnaire research indicated that planetarium audiences have broadening interests. They



Master student Yang Yu outside the building where science communication is taught at Dalarna University. Photo by Lars Broman.

are interested in more and more topics, and to fulfill them correspondingly, the scale of modalities, dimensions, and performance materials in an innovative planetarium like Mediendom should be flexible.

Coexistence and Imbibitions: success of Mediendom: Live performances, such as planetarium dancing with motion capture (React) technologies and starry sky live concert in Wolfburg Planetarium, could be regarded as first-fruits of the "digital theatre" concept. The planetarium utilizes numerous techniques and media to express subjects, and takes advantage of its immersive environment. Meanwhile, it offered an extremely

(Please see **Student** on page 56.)

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## **Forum**



Steve Tidey
58 Prince Avenue,
Southend, Essex, SS2 6NN
England
stidey@hotmail.co.uk

Oh, there you are. I wondered where my

reader was

This issue's column is coming to you from the Thanks For Helping Me Out Department of Forum Towers. Until a few days ago I had a very limited mailbag of responses to the topic for discussion this time round. But you know what? I just thought to myself, "Hey, the solar cycle is at the minimum, so this column is in parity with it!" But then I had a mini surge of contributions, so I thank

everybody below for taking the time to put

down their thoughts on this topic:

As space educators we know a fair bit about the history of humanity's steady growth in knowledge about the heavens over thousands of years. So if you could pick a historical period to watch various astronomical discoveries being made, which one would it be and why?

I emailed Jim Manning a time machine, but he declined to use it. Here's why.

\*\*\*

For me, this is an absolute no-brainer. The answer is "Now." Or, if we want to go historical, the last 50 years or so—the "Space Age." In other words, what I and all those whose teeth are as long as mine have been living for most of our lives. Because we *have* been watching astronomical discoveries being made at a pace unprecedented in the history

of the human race, first-hand and increasingly in real time. No need for the vicarious imaginings of what it would have been like to look over Galileo's shoulder or argue with Percival Lowell about his canals, or freeze our bums off on Mt. Wilson helping Edwin Hubble expose those critical plates that would reveal the spiral nebulae as separate "island universes." All we've had to do is pay attention while the universe is revealed all around us as never—never—before.

Think about what we've experienced ... watching dumfounded as ghostly humans bounced around on the Moon on that hot July night in 1969 ... or as Viking 1 revealed its foot planted in the Martian soil, photographic line by line...the first ever image from the surface of Mars-that gray dawn in 1976 ... or as Voyager 2 presented the unexpected, mottled face of Neptune's Triton in the wee hours of a memorable night in 1989 ... or as Pathfinder improbably bounced to a rocky Martian landscape in 1997, or as its heftier sisters did so several years later to new alien vistas, and that remarkable "holein-one" crater landing that put Martian bedrock literally within reach ... or as NEAR cozied up to asteroid Eros a few weeks after the true start of the new millennium ... or while the Huygens probe beamed back surreal snapshots from the sludgy surface of Saturn's Titan in the chilly winter of 2005 ... or as Deep Impact whacked Comet Tempel 1 a good one just two summers ago. The list is nearly endless. As I often tell students or audiences or just general passers-by, we're privileged to live at an amazing time-a time

when we're seeing, for the first time in all of history, what the solar system is really like.

For me, this is an absolute no-brainer. The answer is "Now."

Not to mention what (caution: obligatory name-drop) the Hubble Space Telescope, its sister orbiting instruments, and groundbased technology powered by clever scientist and engineering brains have done over the years to open up the wider universemaking black holes and other planetary systems real, discovering exoplanets hand-overfist, nailing down the age of the universe, stumbling across mysteries like dark matter and dark energy, getting ever closer to glimpsing the earliest detectable stages of the universe. Not to mention revealing the sheer beauty and elegance of a universe finely tuned to the simple, powerful laws that govern its behaviour. It truly boggles.

First times only happen once. And we've been there more times than we can count. Who could want for more? Just point me toward tomorrow's next jaw-dropping first ...

Jim Manning Space Telescope Science Institute 3700 San Martin Drive Baltimore, Maryland USA 21218

\* \* \*

If I had a time machine and could go back in time whenever I choose, I'd certainly zoom back to Ptolemy's period and try to convince him that the Sun is really at the centre of the universe, and not Earth. That would save us 16 centuries of Dark Ages trying to fit a square geocentric peg into a round heliocentric hole. Imagine where we would be in terms of scientific understanding of the inner workings of the universe if we had not stumbled on that block for so long!

Pierre Chastenay Astronomer, Senior Producer, Astronomy Educator Planetarium de Montreal 1000 rue Saint-Jacques Montreal, Quebec, Canada H3C 1G7

\*\*\*

Without question, I feel that the most fascinating time period in astronomy is between 1670 and 1690. If my history research is correct, a number of events converged in this time period and it is only in retrospect that their importance is revealed.

In 1679 Isaac Newton was lecturing about his optics experiments. His friend Edmund Halley recorded observations of a comet that

> matched the characteristics of another seen 76 years earlier (and later). A few years

later Newton penned *Philosophiae Naturalis Principa Mathemateca* expanding on Kepler's pioneering work in mathematics. In 1675 the Royal Greenwich Observatory was founded, laying the groundwork for many of today's navigational standards.

Meanwhile, the great Polish observer Johannes Hevelius was painstakingly illustrating his measurements of the stars, creating one of the world's great artistic masterpieces. Published in 1690 shortly after he died, the 56 engraved copper plates preserved a set of constellation drawings that make the skies appear to come alive with his imaginative characters.

I can imagine watching these great men as they work, meticulously recording and evaluating, driven by a passion for discovery and a yearning to understand the world around them. Dan Neafus Gates Planetarium Manager Denver Museum of Nature & Science 2001 Colorado Boulevard Denver, Colorado USA 80205

\*\*\*

I am most interested by the earliest sky watchers. Sky myths are common to all cultures so we know how important the sky was to pre-historic people, but why was this? It was probably studied for practical purposes, religious purposes, and maybe just for entertainment.

It's very tempting to portray these early sky watchers as superstitious barbarians. However I think this is very wrong. We only need to look at the cultural sophistication of some modern day "primitive" cultures to know that this is a false view. Even myths such as the Sun being swallowed by a dragon during a solar eclipse are a first attempt at describing the universe in an analytical way. I like to think of these people as the scien-

tists, however unscientific their ideas may seem to us today.

Of course people "looked up at the sky in ignorance," but so do we! Even the astronomers among us do it, let alone the general public. I think this is an important

point to get across: we've learned so much about the universe and yet it is still a universe full of mysteries, both at the frontiers of knowledge and on a fundamental level. Maybe these days we've got a better understanding of how much we don't know. As we learn more and more about our place in the cosmos, we shouldn't forget who laid the foundations.

John Morgan (former planetarian at Thinktank, Birmingham, UK) Instituto di Radioastronomia Bologna, Italy

\* \* \*

If I could pick one period in history to watch, it would have to be the time when the Royal Society was established, and Isaac Newton was alive. I would like to observe meetings of the Royal Society between 1660 and 1750. There were so many discoveries of all kinds. Members of the Royal Society included Sir Isaac Newton, Robert Hooke, Edmund Halley, Robert Boyle, Walter Pope, Edmond Halley, Samuel Pepys, Joseph

Priestly, Charles Messier, and many others.

John Young Audio Visual Producer Reuben H. Fleet Science Center PO Box 33303 San Diego, California USA 92163

\*\*

Yes, thousands of years of accumulated knowledge. There were the early cosmologies trying to explain the movements in the sky. There were the turbulent times after the dark clouds of the middle ages in Europe, which painfully marked the origin of modern science. Then, the discoveries from our technological epoch, with accurate and powerful telescopes, instruments and computers, culminating, so far, with the Hubble Space Telescope. I find the second half of the 19th century a golden era of scientific and intellectual achievement, where different branches of natural philosophy converged in an almost magical way, laying the foundations of modern astrophysics and cosmolo(by then, a well documented conclusion that came nearly 300 years too late for the "heretic" prophecies of Giordano Bruno). The time that produced millions of tiny photographic plates containing the spectra of millions of stars, all compiled in catalogues that we still use today. The stars beautifully classified in the Hertzsprung-Russell diagram, another monument of human intellect.

This was also the time of Hertz, who concluded by experiment that radio waves, heat, and light are the same kind of energy, a combination of electricity and magnetism. The time of Maxwell, who postulated mathematically the behaviour of such electromagnetic energy. The time of the discovery of radioactivity... subatomic particles .... giant telescopes that penetrated the heavens as never before. The foundations of astrophysics, relativity and cosmology that eventually would show our origin and place in the universe.

Dr. Francisco Diego CosmicSky Productions www.cosmicsky.co.uk

\*\*\*

The subject for discussion in the next column will be:

The release of new, traditional, slide-based planetarium shows is clearly on the decline, as is the production of slide projectors. Nobody expects (or wants) them both to wither and

die, of course, but to what extent should this trend be fought against? Is it simply part of the natural evolution of the profession? Can we expect to see a time, no matter how long it takes, when new slide and digital shows can exist together in the profession in comfortable numbers? The numbers of domes converting to digital world-wide will eventually plateau out, of course, but how will the demand for slide-based shows have coped with the transition by then?

I'll be as happy as a kitten playing with a ball of wool if you could send me your thoughts on this topic by the deadline of January 9, 2007, written on the jersey worn by Wayne Gretzky on the night in 1993 when he scored his world record 1802nd point in the NHL, beating Gordie Howie's legendary record. What's that you say? You don't have access to the jersey? Fine, just email me your piece.

I am most interested by the earliest sky watchers. Sky myths are common to all cultures so we know how important the sky was to pre-historic people, but why was this? It was probably studied for practical purposes, religious purposes, and maybe just for entertainment.

gy. For the first time, it was possible to measure the distances to stars. The philosopher concluded that they were so far away that humanity would never know their nature. Yet, scientists found a path by following the colours in the rainbow. Dmitri Mendeleev established a method to classify the chemical elements and produced one of the main monuments of the human intellect, the periodic table. He anticipated empty spaces, reserved to chemical elements yet to be discovered.

Gustav Kirchhoff and Robert Bunsen filled a lot of those spaces, after using small prisms and telescopes in their laboratory to observe the spectra of burning salts. The same technique applied to the stars and Sun gave the answer to the philosopher and went much further. It was the time of Darwin and natural selection as a way of explaining the observed fact of biological evolution.

Huggins and Miller put all this together in a seminal paper to the Royal Society, describing the observed chemistry of the universe as the very same of our planet and of our own bodies, predicting a multitude of worlds similar to ours "amongst the hosts of stars"

## Mobile News



Susan Reynolds Button Quarks to Clusters 8793 Horseshoe Lane Chittenango, New York 13037 USA (1) 315-687-5371 (1) 315-432-4523 (fax) sbuttonq2c@att.net

What an awesome experience it was to spend some time "down under!" Highlights included the unique southern skies, scenery, animals, food, hospitality, "footie" (Australian football), and especially working and visiting with colleagues. We worked hard, laughed, and enjoyed learning from each other while our conference hosts coordinated and facilitated every event with apparent ease. Thank you so much Tanya Hill, Martin Bush, and all others on the Local Organizing Committee and Steering Committee for providing such an amazing IPS Conference! Read the proceedings for a wealth of information of interest to us all. There are too many to list them all here, but I have picked some specific papers and workshops of interest to portable planetarium directors.

#### **Some Papers**

"Gemini StarLabs" by Antonieta Garcia, Gemini South Observatory, Cerro Pachon (La Serena), Chile

"Gemini Observatory, Imiloa Planetarium,

and StarLab working with the Department of Education," by Janice Harvey and Peter Michaud, Gemini Observatory, Hilo, Hawaii, USA

"MEGASTAR, Which Revolutionized the View of Planetariums in Japan" by Yurina Otaki and Takayuki Ohira, Tokyo, Japan

#### **About Mythology**

Papers of special interest to folks who want to know more about mythology:

"Australian Aboriginal Skies," by Paul Curnow, Adelaide Planetarium, Australia

"Native Brazilian Skies" by Alexandre Cherman and Fernando Vieira, Rio de Janeiro, Brazil

"Skylore From Planet Earth" by Dayle Brown, Pegasus Productions, Mishawaka, Indiana USA, who also presented the workshop "Storytelling Under the Stars."

#### Other Workshops

I presented two workshops: "Portable Planetariums: Let's Go Digital?" and "From Southern Skies to Italy with STARLAB" along with Loris Ramponi, Osservatorio Serafino Zani, Brescia, Italy

"The Inside of the Sphere: Teaching Earth Science in a

Dome" and "The Interactive Portable Digital Theatre" by Patricia Reiff, Rice University, Houston, Texas USA; Carolyn Sumners, Houston Museum of Natural Science, USA; and Kerry Handron, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania,

"The portable inflatable digital theatre: 3year progress report" by Carolyn Sumners and Patricia Reiff

"SkyTellers: the once and future space science educators," by Lynn Moroney and Becky Nelson, Lunar and Planetary Institute, Houston, Texas, USA

#### **News From New Friends**

Here is some news from some new friends and colleagues, Marie and Philip, from

They wrote, "It was great to meet you and all the fellow planetarians in Melbourne. We



Takayuki Ohira shows off his latest creation, HOME-STAR, an optical planetarium for household use. Photo by Susan Button





Alexander Cherman (left) inspired us to investigate native stories in our regions before they all disappear; while Paul Curnow (above) helped us look at how a number of Aborig-inal groups viewed the nightly waltz of stars above. Photos by Susan Button

have returned to northern New South Wales at Byron Bay, encouraged by what we learnt from our experiences. We have put together some words you may like to publish together with some pictures.

"This year's conference in Melbourne was really an event that was not to be missed for us. We were excited about meeting so many planetarians and seeing all the latest technology even though our little traveling STAR-LAB is from a different generation. The Starry Night Planetarium visits schools in the Byron Bay, about 150 km south of Brisbane, some of which have less than 60 students and have the show in the local village hall. We call ourselves the "Cosmic Couple" and provide entertainment, education and inspiration in our shows, which include the southern starfield, the constellations, and special presentations using a laptop and video projector. We even have our

own space mascots, Kylie the Kangaroo and Bruce the Koala, fully equipped with Australian flags, space suits, and survival kits. Bruce has his own constellation close to the south celestial pole!

"We have an upbeat song about the Sun, complete with words and images, and presentations on the solar system, aboriginal sky stories, aliens, and the Milky Way. Even kindies and senior physics students have their own show. We also provide pre-show resources and lots of photos of the class groups. Some children even get one of our special home made zodiac chocolates as prizes.

"Having two of us certainly provides a different dimension. We also provide schools with telescope viewing, night sky tours and even rocket launching. The dark environment of the optical projector coupled with the excitement of entering the entrance tube into the bubble is unique and cannot be matched by the newer domes and projectors, besides which it is not really financially viable to upgrade. The FiberArc projector would definitely be an improvement. We love the new technology but believe our friendly, interactive, and fun approach to the shows more than compensates.

"I was impressed by the new spherical mirror projection (Mirrordome), even though shows would eventually move away from just being about astronomy," says Philip, who provides the technical support. From the conference we made lots of new contacts, were amazed by the full dome shows but still feel we have so much to offer with our traveling STARLAB. The motivation is to enjoy what you do and see the excitement and enjoyment reflected in your audience."

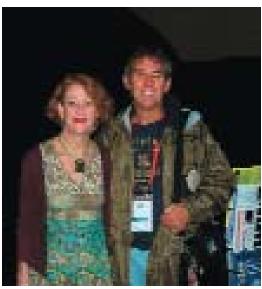
Contact information: Marie Whealing and Philip Hood (Starry Night Planetarium, 6 Aldinga Court, Ocean Shores, NSW 2483 Australia; email: www.starrynight.com.au;

phone: +61(2) 66802448

#### "A Week in Italy" Winner

As I write this column, Carolyn Kaichi is making final plans and will travel as this year's American in Italy contest winner to Brescia. She and Loris Ramponi will work together to bring exciting STARLAB experiences to Italian students who are studying English.

Carolyn has been working with STARLAB for over five years at the Bishop Museum, Honolulu, Hawaii, USA and has worked with all age groups, from pre-school to the general



Marie Whealing and Philip Hood at IPS. Photo provided by Philip Hood

public. She is trained in STARLAB setup, take down and maintenance. She regularly travels to all of the main islands of Hawaii to work with communities and public schools. She currently offers six different programs in STARLAB, all of which she had a role in developing.

Carolyn says, "I am looking forward to bringing an exotic and diverse view of the skies to the students of Italy by sharing the culture of Hawaii and the Pacific."

You can contact Carolyn to talk about her experience and I am sure you will be inspired to apply for this exciting adventure too!

Contact information for Carolyn Kaichi, Planetarium Manager, Bishop Museum, 1525 Bernice St., Honolulu, HI 96817 USA; phone: (1) 808-847-8203; email: ckaichi@bishopmuseum.org

See the Planetarians' Calendar of Events on page 64 for deadline for "A Week in Italy."



Entertainment, education and inspiration in combination put happy faces on Marie and Ocean Shores School children. Photo courtesy Philip Hood

#### **Fourth European Meeting**

Marian Vidovenec and I are currently making plans for the Fourth European Meeting of Portable Planetaria in Europe. At this time we plan to organize this meeting for early in September of 2007 in Bratislava, Slovakia. There is a direct connection with the Vienna airport (60 km), and several European cities have a good direct flying connection with Bratislava´s airport.

Please email Marian (email: marianvidovenec@orangemail) or me for comments, to express interest, and get on our mailing list.

#### Portable Planetarium Project

Ricardo Páez recently wrote to express his frustration about selecting the appropriate projector for a new project he is planning. In light of recent discussions about this and education/entertainment issues, I find his approach interesting:

"Dear Sirs members of the IPS Ad Hoc Committees, Portable Planetarium Committee:

"Sorry for interfere in your time, but I think that you are the best resources to consult my doubts. My name is Ricardo Salamé, from Caracas, Venezuela, South America. (For more about Ricardo, check out h t t p://www.hq.nasa.gov/office/pao/History/alsj/salame.html) I am writing to you because I am seeking to open new enterprise on my country. I want to buy a portable planetarium, and start teaching astronomy in schools and universities, also targeting the shopping malls and private sector events.

"My approach to the business is simple: teach astronomy to special interest groups, and give shows that are entertaining to the general public (especially the children) with a combination of good science. This worked

for me when I worked for the Humboldt Planetarium and in my local radio astronomy show. I want that the people have fun, but also learn something without letting them knowing that they are learning astronomy. This formula helps me in the past to popularize the science."

He expresses his frustration about choosing a projector. "I am feeling the same way, when I was doing the research in buying my new Nikon of film, or to buy a new Nikon digital system."

I am sure he would appreciate some input from you about how you decided which system to choose and if you are happy with your decision. Please communicate with him:

Ricardo Salamé Páez (email: lm11orion @cantv.net)

#### **Planetarium Pet Peeves**

Ryan Wyatt recently shared a list of his pet peeves and I was particularly delighted to see his tips on using a pointer. I feel his ideas bear repeating.

He wrote:

"Pointer Pointers—I've noticed a tendency on the part of many planetarium presenters to get (as Jim Beaber wrote on DOME-L) "herky-jerky" with a pointer, especially a laser pointer. It flits around the dome too quickly for the eye to follow, and because domes tend to have a fair bit of real estate, even a seasoned planetarian can have a hard time tracking a pointer's position. I know I do it, too: getting wrapped up in presenting, one often forgets to consider all the needs of one's audience. But planetarians should keep pointer etiquette in mind when presenting.

"Also, the color of many laser pointers causes problems for some color-blind people, which is another reason to take things slowly. Although an article on "User-Friendly Presentations for those with Limited Color Vision" (http://employees.oneonta.edu/pencehe/MMtutorial6.html) mentions lasers and color blindness only at the very end of the page, it's worth reading for other information, including things such as links to tables of safe web colors for color-deficient viewers.

"Of course, this is only a serious concern for those of us newbies who tend to use those lightweight laser pointers (and particularly for me, given my caffeine intake). There's nothin' like an old-fashioned, twenty-pound 'green arrow' pointer to slow you down! In fact, my earliest presentations relied on the Spitz pointer at the Houston Museum of Natural Science's Burke-Baker Planetarium, and I do believe they benefited from the heft and (quite frankly) ticklishness of the aged device. A nice slow fade-up followed by a gentle arc across the dome... It was impossible to move it too quickly, at least not without hurting oneself, and who can deny the inestimable pleasure of rotating the arrow to match its direction of motion? If nothing else, it seems that a pointer with more heft could help dampen the caffeine- and nervousness-related oscillations that some experience."

Contact Information: Ryan Wyatt, Science Visualizer, Rose Center for Earth & Space, American Museum of Natural History, 79th Street at Central Park West, New York, NY 10024 USA; homepage: http://research.amnh.org/users/wyatt/; email: wyatt@amnh.org; phone: 1 (212) 313 7747

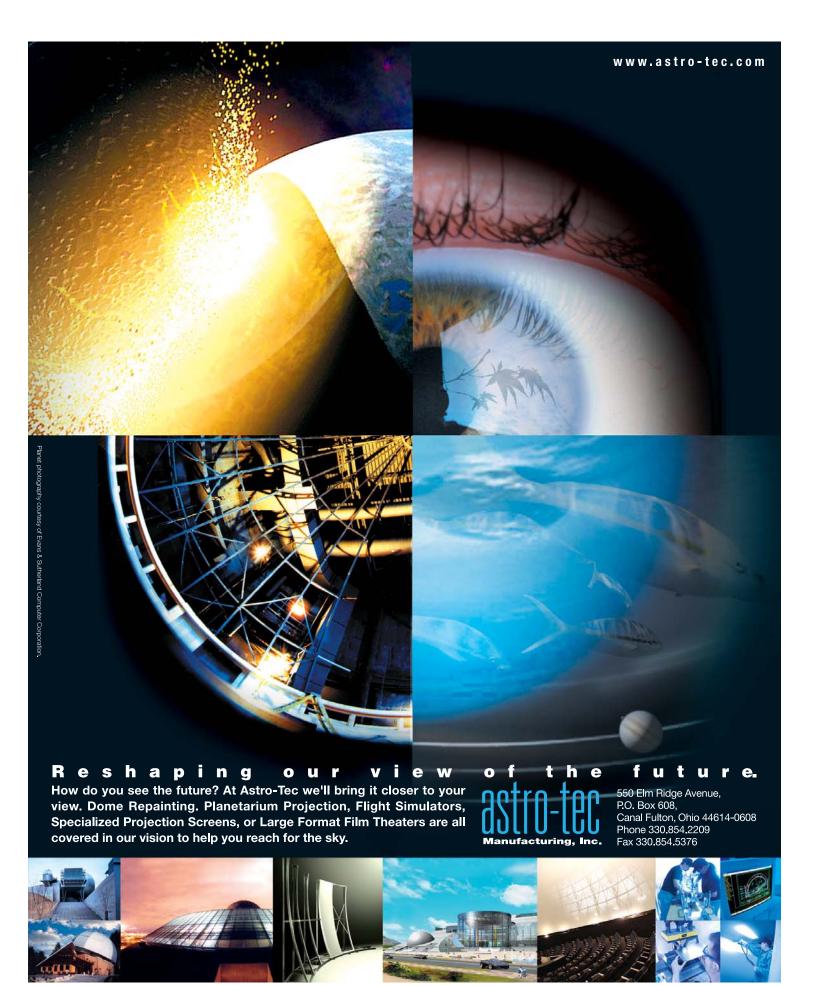
Thank you for these reminders, Ryan! Another trick I learned is that of starting at the zenith to orient your audience, and then slowly moving to the object you wish to highlight. There is another small detail to keep in mind: "persistence of vision," which dictates selective and slow use of a pointer. The retina of the human eve seems to retain an image for a brief time. Viewers, especially young children, experience seeing a "trail" of light behind your pointer sometimes for several seconds. So if you have heard a young audience gasp loudly at what does not seem to be an appropriate moment...you may have made a laser show all over the dome that only they notice!

Signing Off

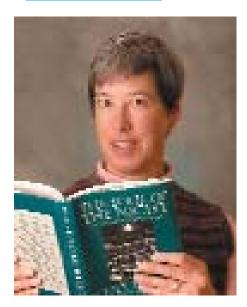
calgary
Science
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productions

check out
our show trailers
and all-sky images
online ®

www.calgaryscience.ca
then click ... csc productions (septytemen)



## Reviews



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

A mix of history and the future for this issue, dear readers. A generous publisher shares volumes about training astronauts, the price of rocket science, and what the next generation of space travelers wonders about.

Thanks to our reviewers: Bruce Dietrich, David Ritchey, and Steve Tidey.

Become one of those famous few! If you'd like a free book to review, contact me at the email address above. Excellent reviewers are always welcome.

All four of this edition's books are from Apogee Books, C.G. Publishing, 1440 Grahams Lane Unit #2, Burlington, Ontario, L7S 1W3 Canada.

#### Kids to Space: A Space Traveler's Guide

Lonnie Jones Schorer and America's School Children, 2006, ISBN 1-894959-42-6, US \$29.95, CND \$33.95, UK £19.95

Reviewed by David Ritchey, James S. McDonnell Planetarium, Saint Louis Science Center, Saint Louis, Missouri, USA

Wouldn't it be great to know every conceivable question a child might have regarding astronomy and space travel? Wouldn't it be even better if all of those questions were compiled into an easy-to-read book, catego-

rized by subject, and then answered by experts in related fields? Well, look no further.

Kids to Space: A Space Traveler's Guide is a wonderful resource for anyone who educates the public (especially children) about the future of manned space flight and the beauty of our Universe. The concept for this project originated in January 2003, when Dr. Buzz Aldrin, who wrote the book's forward, approached the author with the idea of establishing an educational outreach for children focused on the space effort. The outreach became Global Space Travelers, and this book is one of its first steps toward involving children in the exploration of space.

The questions that form the basis for this book were submitted by students ages 3 to 18 from across the United States and Canada. They are arranged into 94 chapters that cover everything from bathing and going to the bathroom in space to rocket technology, alien life, and black holes. One of the book's subtle beauties is that complex ideas and theories are explained in basic terms.

Even though the answers come from astrophysicists, engineers, astronauts, and other renowned experts, they are written in a manner that, well, even I can understand. And the answers do make for enjoyable reading. Not only do you get such basic information as 93 million miles being the distance to the Sun, but you also get from Derek Webber, Washington DC director of Spaceport Associates, that the Sun "is so far that even light takes eight minutes to cover the distance. In fact, when we see the Sun, we are seeing it eight minutes ago. Imagine! It may not be there now." In answering how we go to the bathroom in space, former astronaut William Pogue actually explains the differences between going "number one" and "number two."

Many space science books have a tendency to become quite technical and can be understood and enjoyed only by a rather narrow audience. Even the "armchair astronomer" can find it difficult to fully

If you make presentations to children, this book is a valuable reference; it not only provides answers to intriguing questions, but also offers an insight into what kids wonder about and how they think.

comprehend much of what is written about our universe. It is quite refreshing to see a comprehensive effort aimed at such a large audience, for this book appeals not only to kids, but also to the adults who teach them. If you make presentations to children, this book is a valuable reference; it not only provides answers to intriguing questions, but also offers an insight into what kids wonder about and how they think.

Accompanying the book is a CD filled with over 1,000 drawings and illustrations submitted by children and put together in PowerPoint format. The amazing artwork assembled here offers a kids'-eye view of what it would be like to live and travel in space. This added feature is a perfect visual to run in a freestanding kiosk or display that will draw the attention of your visitors.

It's an old saying, yet undeniable: children are our future. In the book's prologue, Sir Arthur C. Clark writes, "It's hard for me to realize that nobody under the age of 30 alive today was even born when Neil Armstrong took that 'one small step' onto to the moon and changed history forever." This book aims to bridge the gap between us and our future by fueling the imagination and wonder of a new generation about the beauty and wonder of space exploration. It could not have come at a better time.

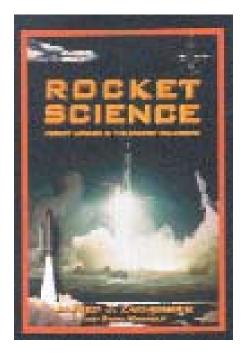
#### Rocket Science in the Second Millennium

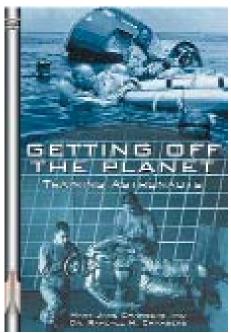
Alfred J. Zaehringer with Steve Whitfield, 2004, ISBN1-894959-09-4, US \$20.95

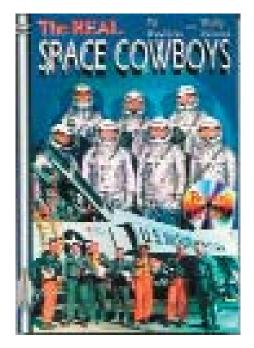
Reviewed by Bruce L. Dietrich, Wyomissing, Pennsylvania, USA

In *Rocket Science in the Second Millennium*, Alfred J. Zaehringer reveals that he coined the term "rocket science" in 1947. At that time he used the phrase to encompass all of the branches of modern science,









technology, and engineering devoted to rocketry and space flight. Today, what has sometimes become a rude metaphor includes any complex and intellectually demanding activity, and by extension, its practitioners must be highly intelligent. Now Zaehringer has written a brief history of rocketry and space sci-

ence for the layman.

During his World War II
US Army Service,
Zaehringer became
intrigued with the very
weapons of which he was
the target. Ultimately,
after a stint at the
University of Michigan, he
followed his interest in
rocketry with sufficient
avidity to become chief

test engineer for the best-known American rocket manufacturer, the Thiokol Corporation.

Rocket Science begins with a 32-page history of rocketry, from eleventh century Chinese fireworks through the German Aseries of military weapons (A4-V2) and the Cold War Space Race. Easy lessons in Newton, basic physics, and thermochemistry dominate the second chapter prior to his piece d' resistance, "Rocket Science Economics."

In an attempt to disabuse readers of any political or historic naiveté, he undertakes a simple economic analysis, concluding that the only payoffs from space are "information, communication, weather, and Earth surveillance," Zaehringer says. "Everything else just costs. To play the space game, you had better pay the piper. Space is no place for the poor; if you want to go there, you

had better be ready to pay, and pay, and pay!"

He observes that because rockets propel only small payloads and truly economical reusable launch systems don't yet exist, a strategy based on long-term affordability must be developed. Several proposals for

Rocket Science begins with a 32-page history of rocketry, from eleventh century Chinese fireworks through the German A-series of military weapons (A4-V2) and the Cold War Space Race. Easy lessons in Newton, basic physics, and thermochemistry dominate the second chapter prior to his piece d' resistance, "Rocket Science Economics."

future space transportation using a limited number of future technologies are outlined.

This promising book remains so. Side by side with truncated and trivialized political history there are many fine historic photographs, charts, and drawings; however, these often don't seem to line up with the text. A strictly edited second edition would be well worth the effort.

#### Getting Off the Planet: Training Astronauts

Mary Jane Chambers and Dr. Randall M. Chambers, 2006, ISBN 1-894959-20-5, US \$18.95, CDN \$23.95, UK £ 12.95

Reviewed by Steve Tidey, 58 Prince Avenue, Southend, Essex, England

I usually love books such as this, which give the reader an insight into all the other-

wise unsung work that happened in the background, away from the world's cameras, which was collectively essential to getting the Mercury and Gemini astronauts into orbit and the Apollo astronauts to the Moon. *Earthbound Astronauts* (1971, by Bernie Lay) is one of the finest examples of that type of

book.

But, unfortunately, in this instance I was disappointed to find that there was very little that was new to me in these pages. The writing is perfectly good (if a little dry and too textbook-like for a wide audience), but the material covered is largely well known to people in our profession who have seen and read Tom Wolfe's *The* 

Right Stuff, read some of the other similar books, or seen films over the years that show detail of the stringent training the astronauts had to endure. Co-author Dr. Chambers was a key player and innovator in the design of the astronauts' training regime at the Aviation Medical Acceleration Laboratory in Warminster, Pennsylvania.

But the book does contain some interesting bits of information here and there, and I feel sure that you will probably not have seen before many of the dozens of interesting pictures that accompany the text. The best one is the lower picture on the book's cover, which shows an astronaut strung up at a 90-degree angle to practice walking in simulated 1/6th lunar gravity.

Amongst some of the peculiarities you'll learn here are:

• before monkeys were chosen to precede Alan Shepherd into space, flight surgeons seriously considered sending up pigs and bears (huh!);

- a senior Air Force officer suggested training monkeys to fly combat planes (the same full size ones human pilots fly!) in preparation for going into space (he was quickly retired early, surprise, surprise);
- to keep the weight of the spacecraft down, an ill-fated proposal was made early in the Mercury program's development to incorporate edible clothes and equipment (hey, my nose isn't growing longer, so all this stuff must be true);
- and, at least in the early days of the Mercury program, visiting reporters had no idea what to ask the scientists because they knew hardly anything about the subject of going into space, and the scientists had no idea what to say to the reporters as they

A fair amount of the book is given over to discussions of the human centrifuge that was famously used by the early astronauts. Dr. Chambers headed up the team of scientists and engineers who designed and built it, so he felt it incumbent upon himself to test the equipment on himself . . .

weren't sure what the reporters knew and didn't know, so the early news conferences were brief, awkward, damp squibs, to say the least

A fair amount of the book is given over to discussions of the human centrifuge that was famously used by the early astronauts. Dr. Chambers headed up the team of scientists and engineers who designed and built it, so he felt it incumbent upon himself to test the equipment on himself a great many times before subjecting the astronauts to the high G forces. He wanted to know from firsthand experience what they were going to experience, so he could gauge the equipment's usefulness. It was therefore interesting to read his exploits as he and his colleagues took dozens of rides on the centrifuge over nine months, to test how many Gs the human body can take and what the best angle to sit at was. Upside down, right angles to the main physical forces, etc. This was one of the few places where the book really came alive for me.

So, in conclusion, I would say that if you're a space educator with the average amount of knowledge about astronauts and their training that we in the profession tend to pick up automatically over the years, you will probably gain by simply flicking through the book in a shop, appreciating the pictures and learning a few interesting facts here and there in the text. But if you're Joe Public who has never seen astronaut films or

read similar books, I can recommend it as a good buy, with its insights into the amazing things that early astronauts had to do to ensure they were fit to travel beyond the atmosphere into what, at the time, was a completely unknown environment.

#### The Real Space Cowboys

Ed Buckbee and Wally Schirra, 2005, ISBN 1-894959-21-3, US \$29.95, CND \$36.95, UK £17.95

Reviewed by Steve Tidey, 58 Prince Avenue, Southend, Essex, England

Many of us have read books about the Mercury, Gemini, and Apollo programs written by either the astronauts or by some other insider, but this book has a unique angle: one of its co-authors, Ed Buckbee,

became NASA's public affairs officer at the Marshall Spaceflight Center soon after development of the Mercury program began. He stayed with NASA through to the late 1990s, by which

time he had become the prime mover behind the development of Space Camp at the Kennedy Space Center. I found it interesting to read the PR department's view of many of the well known events that occurred during NASA's glory days of the 1960s.

On this point we're treated to some amusing anecdotes, such as finding out that

whenever the foreign press visited the Marshall or Kennedy centers, they all assumed Werner von Braun was head of NASA, as he was getting all the glory in the media! This irritated his bosses, and eventually they stopped inviting

von Braun to take part in press conferences. And there was a constant battle between the press office and the Mercury astronauts to make one of their fold available for press interviews and pictures almost every day. A compromise was reached in which Al Shepard would nominate one astronaut to be made available (or "sacrificed," as he put it) for a short time just once a week to satisfy the press.

I always find it useful to contrast the cando ethos of NASA in the 1960s (which comes across in this type of book) with the current

NASA, which tries to be can-do but seems hidebound by so many things in the modern world that didn't exist back then. So it was useful to read here a quote from Wally Schirra in which he says, "I don't know if NASA could handle a von Braun today. They are so bureaucratic. In my day we had an inspired can-do agency. We had a president who was committed. We had Jim Webb who could sweet talk the Hill and the White House, and we had von Braun to sell the program."

The slogan around the NASA offices in those days was "Late to bed, early to rise, work like hell and advertise!" And, boy, did they ever. The book's text is quite inspiring, and one gets a real sense of remarkable people exploring a new scientific and technical frontier with great enthusiasm, feeling their way almost in the dark much of the time. They were all the right people in the right place at the right time.

Some of the astronauts' hang-ups are explored, one being their extreme irritation with being compared with the monkeys that preceded them into orbit. Shepard is quoted saying, "I get a little tired of checking every simulator and capsule seat for primate poop before I climb in." Er, yes, quite...

The Mercury astronauts often relieved the tension of training by playing a "gotcha" on each other. This normally involved practical jokes that embarrassed a colleague in public. Many of these are spread throughout the book, and one gets a clear sense that the camaraderie that this helped build between the original seven astronauts welded them together into lifelong buddies. And there are many quotes, some from as recently as 2004,

So this is a fine book. There are lots of little insights I'd not come across in other publications, and the many astronaut interviews bring to life areas of the text which would otherwise have been rather ho-hum without the addition of knowing what the guys in the capsules thought . . .

which show that that closeness is still as strong as ever.

Buckbee's association with Space Camp takes over in the latter chapters, as he describes how it grew from an idea suggested by von Braun in the early 1970s. Buckbee certainly has a fair-sized ego, as he features in probably half of the many interesting pictures that accompany the text (or, more likely, they're from his own collection). It's clear that he admired Al Shepard perhaps the

(Please see **Reviews** on page 56)

## Quality, accuracy, innovation, service, support, experience & options for all . . .

#### **Projector Options**



#### The STARLAB Standard

- Affordable
- Easy to operate
- Extremely low maintenance
- Versatile, with a wide array of cylinders and curricula
- Daily motion control
- Accurate, precise starfield of over 3000 stars, with the 14 brightest individually lensed for size and magnitude accuracy



(Analog

#### The STARLAB FiberArc

- Fiber optic technology
- Superior, bright, color-accurate, starfield of over 3000 stars, with more than 70 stars individually lensed for size and magnitude accuracy
- Added professional features such as:
  - Built-in meridian and cardinal points projectors
  - Goose-neck side lamps
  - Variable speed & direction daily motion control
- Near zero dark adaption time



#### The Digital STARLAB (digital)

- DLP projector with best-in-class contrast of 7000:1
- Patent-pending fisheye lens projecting small, bright, accurate stars covering a full 180°
- Powered by user-friendly Starry Night Small Dome™ software
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- Displays slides or movies

#### **Dome Options**

## The STARLAB Standard (4.9m & Giant Dome (6.7m)

- Affordable
- Lightweight
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- Long-lasting
- Opaque
- Quick & easy to set up and maintain

#### The STARLAB Digital Dome

- Super smooth projection surface
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- Opaque
- Walk-in entry



"I keep getting excellent reports on the Digital STARLAB. We are using it with the public, with visiting school groups, with private events, and with ongoing education classes. . . . Enormous potential here."

## that's why LTI.

## General Counsel



Christopher S. Reed CSR Media, LLC 12106 West 75th Lane Arvada, Colorado 80005-5306 USA 1-720-236-3006 phone 1-760-466-6440 creed@csrmedia.com

Readers of my previous columns and articles will recall a concept in copyright law called "work made for hire," which essentially alters the general rule that the creator of a copyrightable work is automatically the copyright owner. Because planetarium shows are often assembled with pieces from many different creators, sorting out who owns what rights can become complicated, depending on the relationship of the parties engaged in the creation. This quarter's column brings a look at some of the dynamics of a "work made for hire" relationship.

#### "Work Made for Hire" Defined

The concept of a "work made for hire" comes directly from the Copyright Act itself, where the relevant portion of the definitions section, 17 U.S.C. § 101, reads:

A "work made for hire" is: a work prepared by an employee within the scope of his or her employment; or a work specially ordered or commissioned for use as a contribution to a collective work, as a part of a motion picture or other audiovisual work, as a translation, as a supplementary work, as a compilation, as an instructional text, as a test, as answer material for a test, or as an atlas, if the parties expressly agree in a written instrument signed by them that the work shall be considered a work made for hire.

Section 201 of the Copyright Act, the section that deals with copyright ownership, reads:

Works made for hire. In the case of a work made for hire, the employer or other person for whom the work was prepared is considered the author for purposes of [copyright law], and, unless the parties have expressly agreed otherwise in a writ-

agreed otherwise in a written instrument signed by them, owns all of the rights comprised in the copyright.

A plain-English reading of these two sections together suggests that copyright in works prepared by an employ-

ee, for an employer, within the scope of the employment relationship, vests in the employer. Though it seems relatively straightforward, these two sections have given rise to a substantial amount of litigation, arguing over what constitutes an employment relationship, what constitutes activity within the scope of employment, and a host of other issues.

#### Works Prepared in an Employment Relationship

The first question frequently raised by the work made for hire (WMFH) doctrine is what constitutes an employment relationship. In 1989 the Supreme Court had the opportunity to set forth specific guidelines for determining when an employer-employee relationship exists, as opposed to an independent contractor relationship, in Community for Creative Nonviolence v. Reid, 490 U.S. 730 (1989). Rather than develop new rules for the copyright context, the Court opted to simply apply generally applicable factors used across various fields of law.

In determining whether a party is an employee or independent contractor, courts consider the degree of control that the employer had over the alleged employee, the degree of skill involved in the work, the

source of "instrumentalities and tools" used in the creation of copyrightable work, where the work took place (employer's workplace or the alleged employee's own place of business), the nature of payment (regular salary payments versus payment on a per-project basis), the ability of the alleged employee to hire assistants and other staff, and the tax status of the alleged employee.

Even after establishing an employeremployee relationship, copyright only vests in the employer if the work undertaken by the employee falls within the scope of the employment relationship. This analysis is somewhat more straightforward, but still raises issues. Generally, something falls within the scope of the employment relationship if it is of the nature and type of work generally performed by the employee. Although the

Even after establishing an employeremployee relationship, copyright only vests in the employer if the work undertaken by the employee falls within the scope of the employment relationship.

court will look to employers' job descriptions when determining whether certain work falls within the scope of employment, they are not, by themselves, determinative.

The issue comes up with some frequency in the education community, when teachers prepare instructional materials in which the school or school system later attempts to claim ownership. The prevailing view in such a situation is unless the employer specifically requested the creation of such materials and provides unique resources to the employee to create such materials, the work was not prepared within the scope of employment and copyright will be held by the employee.

Applying these two concepts simultaneously, it is clear that copyright in works prepared by an employee within the scope of an employment relationship with an employer is held by the employer, absent an agreement to the contrary. The corollary, then, is that works prepared by an independent contractor, even at the specific direction of the person or entity commissioning the work, is held by the independent contractor, unless other arrangements are made.

#### Works Prepared Outside of an Employment Relationship

As established above, works prepared outside of an employment relationship are owned by the creator. This even includes cases when a work is specially commissioned

General Counsel is intended to serve as a source of general information on legal issues of interest to the planetarium community. Planetarians seeking information on how the principles discussed in a General Counsel column apply to their own circumstances should seek the advice of their own attorneys.

by someone; unless a specific arrangement is reached regarding the underlying copyright, such rights are owned by the creator, regardless of who paid for the work or the circumstances giving rise to the creation of the work

In developing the Copyright Act, though, Congress recognized that there are some instances where third-party, non-employee contributions to copyrightable works are so frequent, that it was advisable to allow parties to easily transfer ownership of the copyright from the creator to the commissioning party.

To qualify for WMFH treatment, absent an employment relationship, a work must fall into one of the nine categories set forth in the statute: a work specially ordered or commissioned for use as a contribution to a collective work, as a part of a motion picture or other audiovisual work, as a translation, as a supplementary work, as a compilation, as an instructional text, as a test, as answer material for a test, or as an atlas.

Once it is established that the work qualifies for WMFH treatment, the parties must agree that the work will be treated as a WMFH and that the copyright will vest in the commissioning party. The courts disagree as to the timing of this writing, specifically whether it must be signed before the work is created, but sound legal practice is to include the WMFH provision in the same written document that provides for the working relationship between the parties and have it signed before any work begins.

#### "Forcing" A Work Made for Hire

It is extremely common for contracts relating to the creation of copyrightable work to include a clause that essentially says everything created under the contract will be considered a work made for hire and copyright will vest in the commissioning party. Unless the work is one of the nine categories set forth in 17 U.S.C. § 101, however, this language will be ineffective.

Put differently, unless the work was prepared within the scope of an employer-employee relationship, or the work at issue falls into one of the nine categories in 17 U.S.C. § 101 and the parties agreed to consider it a work made for hire at the time the contract was entered into, then the work cannot possibly be a work made for hire, even if the parties say so in the contract.

So how can one acquire rights in a work prepared by a third party if it does not qualify for WMFH treatment? The answer is what lawyers often call a "short form assignment," which essentially amounts to a statement that the creator grants to the commissioning party all of its rights, titles, and interests in the intellectual property that arises as

a result of the creation of a work of authorship.

Strong, well written agreements will include language to cover both potential cases, including both a statement that if the work qualifies as a WMFH, it is to be treated as such, with copyright vesting in the com-

Perhaps the most clear-cut example is an individual hired by a planetarium to work as a program producer.

missioning party, and a statement that if the work does not qualify for WMFH treatment, that the creator transfers and assigns all of its right, title, and interest in the work to the commissioning party.

#### The Practical Impact

With the legal framework firmly in place, we can consider some situations that appear in a planetarium context on a nearly daily basis.

Perhaps the most clear-cut example is an individual hired by a planetarium to work as a program producer. The copyright to any planetarium shows, programming elements, or related material would be held by the planetarium and not the employee. However, if the employee were to write a

manual on planetarium show design, or perhaps contribute to a professional publication such as the *Planetarian* or a regional planetarium society newsletter, such work would likely fall outside the scope of employment, and the employee would own the copyrights.

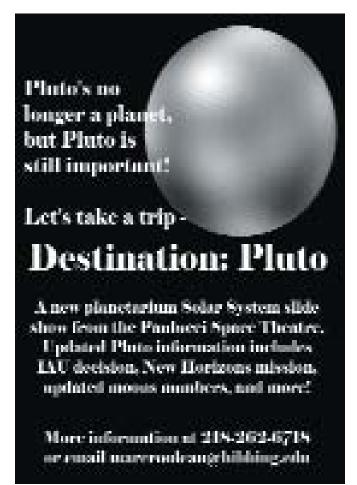
Where the WMFH doctrine becomes more involved is when a planetarium makes use of third parties to prepare elements that get folded into a unified production. A typical planetarium production might include contributions from outside artists, composers, scriptwriters, and other creative professionals, all of whom retain the rights in their creations unless the contracts say otherwise. Although this fact is unlikely to hinder your own use of the work under your own dome, it may raise significant barriers should you desire to repurpose the production or distribute it to other facilities.

To combat this potential problem, care should be taken to include the appropriate

language in agreements with third party service providers. The average planetarium show would likely be considered a "motion picture

or other audiovisual work," thereby qualifying the work to be done by the contractor to be treated a WMFH if the parties opt to do so.

Although circumstances vary widely and the precise language should be drafted by an attorney after reviewing your specific situation, a typical contract for creative services should include a description of the project and recite the fact that the results will be included in a planetarium show which constitutes an "audiovisual work" under § 101 of the Copyright Act. The agreement should further provide that the parties agree the work will be treated as a WMFH and that copyright will vest in the planetarium. As a backup, a short form assignment is also advisable in case it is later held that the work did not qualify for WMFH treatment.



## President's Message



Martin George, Curator Launceston Planetarium Queen Victoria Museum Wellington Street Launceston, Tasmania Australia +61(3) 63233777 +61(3) 63233776 fax martin@qymaq.tas.gov.au

Firstly, congratulations to Sharon Shanks for a wonderful edition of the *Planetarian* in September and for her continued wonderful work in producing this issue. Just after Sharon had reached the final stage of production of the September issue, I met with her in Ohio to discuss the journal and I look forward to Sharon being editor for many, many issues!

Once again, do remember that this is your journal, and Sharon welcomes contributions from members around the world.

#### Navigating the Continent

Recently, I presented a talk to a group of very interested people in Hobart, Tasmania. As part of a special week called Map Week, I had been invited to speak about the longitude problem and its relevance to Australia.

In the late eighteenth century, the first maps were being drawn of the east coast of the Australian continent, and its most famous explorer in those early days was Captain James Cook. On the voyage during which he observed the 1769 transit of Venus and charted the eastern Australian coast, Cook was making good use of the "lunar distance" method of calculating time, and it was only on subsequent voyages that he had a chronometer. Cook's voyages, and those of several others, are an important part of Australian history, and the navigation methods of so many explorers were associated with the problem of finding longitude. Naturally, I spoke extensively of the importance of astronomy in solving the problem.

I am mentioning this because as I was making the two-hour journey home, I was reflecting on all of the things we do as planetarians, as I had done after participating in the Pluto occultation observation that I mentioned in the previous issue. At IPS conferences, especially, I often find myself discussing this important and very rewarding aspect of our work. So many of us do much more than the activities that we perform in our domes and in our associated astronomy and space exhibits; there are many outreach activities which we are called upon to do. In some cases we become involved with the media, appearing on radio and television programmes. We also present talks and lec-

tures to groups, both in lecture rooms associated with our planetariums and at more remote locations.

## It's All Part of Being a Planetarian

And, of course, many of us take telescopes out into the field to entertain groups of people with a wide variety of interests who simply want the excitement of looking through a telescope at the night sky.

One of my favourite activities of this type is to take a telescope to Camp Quality, which is a weekend, or sometimes week-long, camp for children with cancer. It's a very rewarding experience to see the children's eyes light up when they see us arriving, and

to witness their excitement when they first see craters on the Moon or the rings of Saturn. Peter Daalder, a valued planetarium volunteer here in Launceston, accompanies me on these trips, which see us heading to a location a long way from the city lights to a place where the Milky Way decorates the sky so beautifully.

To me, it's all part of being a planetarian. On to a topic that has everyone talking.

#### **Defining Pluto**

Since the most recent issue of the Planetarian was printed, one of the most controversial decisions in astronomy has been made-the IAU decision on the definition of a planet in our solar system which, as we all know, excludes Pluto from the "planet club." Dome-L has seen a great deal of discussion about this and it's interesting to see all of the points of view. One problem is that the planet definition applies only to our Solar System. I felt that it could have been widened, and have much more to say about this in an article appearing on page 34 in this edition of the Planetarian. I feel that, for several reasons, the matter is far from over. No doubt there will be further debates, especially before and during the next General Assembly of the IAU, which takes place in Brazil in 2009.

Speaking of the IAU, the public perception of the 2006 General Assembly in Prague seems to be that it was all about Pluto. This was, of course, far from the truth. There were two weeks of papers and activities covering the entire spectrum of astronomical topics.

During the Assembly, I presented the 2006 Grote Reber medal for lifetime innovative contributions to radio astronomy to Mrs. Crys Mills, who was accepting the medal on



Children at Camp Quality in Tasmania enjoying their views through a telescope, guided by Launceston Planetarium volunteer Peter Daalder looking on (behind the woman in blue). Photo by Martin George

behalf of her husband, Bernard Mills, who established the famous Mills Cross radio telescope west of Sydney.

Significantly, I met with quite a few people there who were very interested in the planetarium field, and at a meeting of IAU Commission 46—Astronomy Education and Development—I agreed to work towards closer ties between the IAU and the IPS. Outgoing Commission 46 Chair Jay

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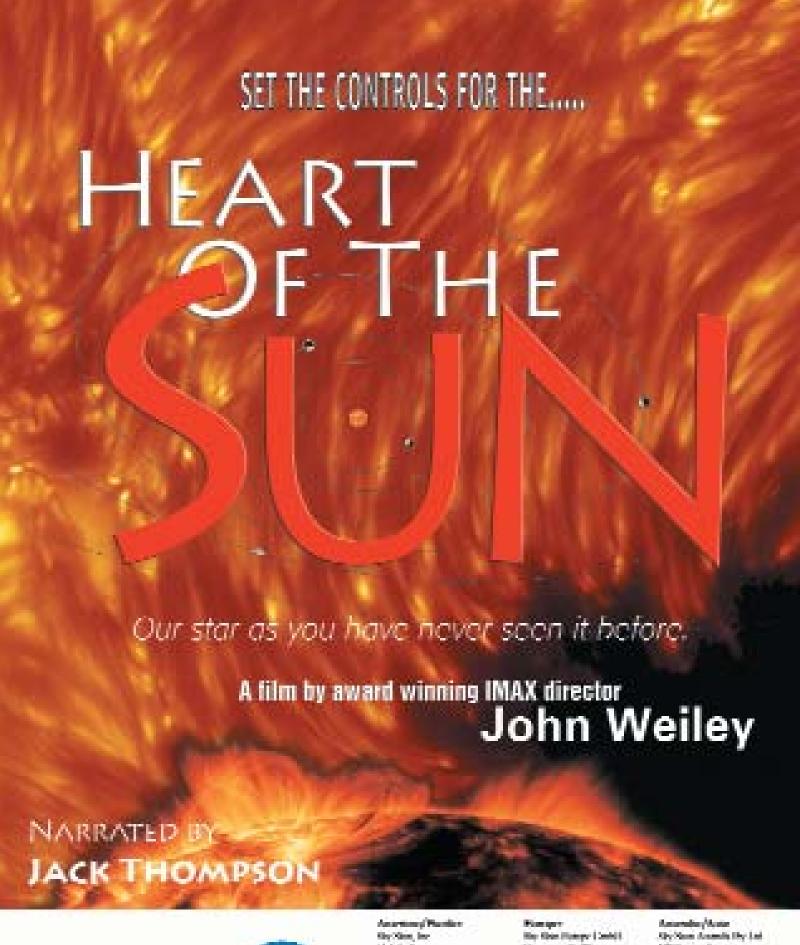
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## <u>Digital Frontiers</u>



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While there's been a flurry of passionate discussions on the Dome-L email list triggered by the recent IAU re-classification of Pluto as a dwarf planet, those who frequent Ryan Wyatt's fulldome.org list have been witness to a flurry of equally passionate—and in some respects, extraordinary—discussions about digital domes, the future of planetariums, and the future role of IPS.

#### **Expanding the Dome**

Interestingly, the "fulldome" medium (as our community has affectionately dubbed it) has attracted a great deal of interest from artists, filmmakers, educators, engineers, and other professionals with roots outside of the planetarium profession. These individuals question why so many versatile "virtual reality theaters" should be dedicated to astronomy topics alone. Some have even questioned the appropriateness of IPS as the organization to lead professional advancement of the rapidly growing fulldome community. They point out that IPS's support programs and membership are deeply rooted in the tradition of astronomy education-not technology, filmmaking, virtual reality, or art.

Others point out that there would be no fulldome medium if not for pioneering planetarians and institutions, and the support of IPS alongside the many regional chapters who have welcomed vendors and their digi-

tal wares in recent years. Clearly the full-dome medium was born within the planetarium community and has largely been nurtured by innovative planetarians who are eager to enter the digital age.

At the same time, "next big thing" demonstrations have dominated dome time at most planetarium conferences, leaving some traditional planetarians feeling left out. The "my starball is bigger than your starball" divide seems to have shifted in the minds of some into one of digital haves and have-nots. Of course, those of us who have lived in both worlds know how powerful a simulated night sky can be as a storytelling device—a power that digital systems have yet to fully tap with their limited contrast and resolution. Digital producers and storytellers have much to learn from traditional planetarium arts

#### **Supporting Digital**

If you take an honest look at the issues raised by the fulldome community, you see

that they are driven by legitimate needs, concerns, and visions that deserve a supportive and understanding professional society. IPS has been meeting

the needs of a niche profession focused on astronomy education, so it is not surprising that support is currently lacking in areas that will be crucial for nurturing fulldome into maturity. A number of long-time IPS members and officers recognize the unique challenges of supporting the digital dome community, and are making an effort to rise to these challenges. Here's a few of the issues that have been raised:

1) Inclusiveness. Vendors are traditionally not part of the organizational core of IPS. However, the vendors are the ones who have created and driven the new digital technologies and they remain integral to advancing the profession. Indeed, there can be issues with corporate rivalries and bias, but they are not fundamentally unlike institutional rivalries and bias. Well-run professional societies do not tolerate overt favoritism or commercialism from anyone. Inclusiveness means support for technical exchange, standards development, and other activities that reach out and support the larger community of stakeholders.

**2)** Recognition of technical innovation. IPS needs a program to recognize or reward technological advancement in the profes-

sion. There is a juried reward for the best planetarium script, but there is not an IPS award for excellence in things like theater design or technological innovation. Showcasing and supporting successful innovators recognizes those who are truly benefiting the profession, and raises the bar for others.

3) Timing. The equipment that planetarians have traditionally used to work their magic-star projectors, slide projectors, special effects, and audio systems-has not been subject to fundamental changes in decades. The substantive market changes wrought by digital projection have primarily occurred in the past four or five years with the refinement of real-time digital planetarium capabilities that reproduce (and sometimes surpass) traditional star projector motions. In this time period, IPS has had three conferences. Fulldomer's have commented that this is too infrequent, considering the pace that these technologies are developing. They want a professional society that provides dedicated international support and leadership for the rapidly growing digital dome

This shared desire for planetariums to offer meaningful programming could be the common ground needed to redefine the mission of planetariums and embrace a larger agenda.

4) Infrastructure and financial support. IPS is a volunteer organization without a paid staff. This vastly reduces the level of support that is possible from this organization. The fulldome community could benefit from an actively managed website, a newsletter, a serious standards effort, etc. These things can be funded by grants, but even this requires a dedicated staffer or secretariat to support the writing and administration of a grant.

#### **Diversity and Commonality**

5) Diversity of programming. By definition, the planetarium is a kinetic diorama of the celestial sphere portrayed from a geocentric eyepoint. The fulldome community is exploring a wide range of programming across the arts and sciences, and they seek an expanded definition of the planetarium. In a recent email list discussion there seemed to be agreement that planetariums should stand for "meaningful media," programming that uplifts, enlightens, educates, or otherwise transforms visitors in a positive way. There was general consensus between planetarians and the fulldome community that media entertainment of an expressly commercial nature-such as IMAX's recent foray into Hollywood films—was not their primary interest. This shared desire for planetariums to offer meaningful programming could be the common ground needed to redefine the mission of planetariums and embrace a larger agenda.

6) Image. When school planetariums are seen as classrooms dedicated to astronomy, they must compete with all the other arts and sciences for survival. Astronomy is no longer a leading educational objective for schools, resulting in school planetarium closings in recent years. Public planetariums have also struggled to attract visitors and have suffered closings. Some fulldome enthusiasts feel that the prevailing public perception of planetariums could limit the success of the new fulldome facilities. Indeed, many large public institutions have changed their name in an attempt to rebrand the traditional planetarium, i.e. Cyberdome, Imaginarium, or Virtuarium. This image issue needs to be addressed.

7) Inertia. Perhaps the biggest concern that the fulldome community has expressed is the difficulty of changing years of inertia within the planetarium community. Should fulldomers try to re-invent IPS to meet their unique needs? Will they be granted sufficient autonomy to evolve the medium? Can IPS deal with rapid change? It has been suggested that IPS's Full Dome Video Committee, now lead by Ryan Wyatt, be granted a degree of autonomy similar the Association for Computing Machinery's special interest groups including SIGGRAPH, ACM's special interest group (SIG) for computer graphics (GRAPH). A fulldome SIG within IPS would support issues that are uniquely digital in nature (i.e. standards, production issues, show distribution, etc.).

#### Recognizing the Importance

The officers of IPS recognize the importance of fulldome to the planetarium profession and have expressed a desire to nurture this growing community. Discussions with Martin George, Shawn Laatsch, Jon Elvert, and other IPS officers have affirmed this. Candidates for IPS president elect have reached out to the fulldome community for feedback and to offer support. If the energy and momentum of the fulldome community is embraced and supported, it will revitalize IPS and the planetarium community as a whole. At the same time, it must be recognized that IPS has many duties and supporting the digital planetarium is but one of them. IPS must continue to support the full spectrum of planetariums, from portable to classroom to public institutions, whether digital or optomechanical.

Times of change bring challenges and opportunities alike. Now is a good time to re-

examine what a planetarium is, what it could be, and how IPS can assist in this natural evolution of the dome. By taking a leadership role in the digital revolution, IPS can

turally enriching use of this new medium and will position the organization for renewed growth and a bright future. ☆

maximize the positive, educational, and cul-

#### (**Student**, continued from page xx)

Meanwhile, it offered an extremely wide range of subjects and interests: "rainforest" combined the rainforest and starry sky (biology astronomy) in one show, "Magellan" fixed historical events and ancient astronomy in another, for which they received mostly positive feedback. These phenomena showed us that importing fresh elements into planetariums renews vital force and brings higher quality effects into the programs. The coexistence of such areas as public education, enjoyable subjects, and realtime news, among others, would be one

important trend for future planetariums.

The important trends that seem to be emerging are well-designed and continually-improving innovation, holistic foresight, and detailed and individual schemes for programs. I, of course, will continue my research. I think my study will be very helpful for all upgrading and new generation planetariums and their direction of growth in the future.

Acknowledgement: I unfeignedly and gratefully acknowledge the grant from the Armand Spitz Fund for Planetarium Education that helped finance my "development trend study" in Germany and master studies in Sweden.

#### (Reviews, continued from page 44)

most, as Shepard gets the lion's share of the book's attention. And that's not just because he made the first sub-orbital flight. No, he clearly epitomised the type of character that NASA was looking for as the first person to brave sitting on a rocket that could have blown up. The closing chapter has a moving account of Shepard's and his wife's ashes being spread over the Pacific from two US Navy helicopters, and this is preceded by quotes from the surviving Mercury astro-

nauts, who read eulogies for Shepard.

So this is a fine book. There are lots of little insights I'd not come across in other publications, and the many astronaut interviews bring to life areas of the text which would otherwise have been rather ho-hum without the addition of knowing what the guys in the capsules thought about various topics and concerns. It's another fascinating reminder of what a marvelous achievement the Mercury, Gemini, and Apollo programs were, and it makes one hope that we can find such worthy people again as the modern day Orion program to the Moon and Mars gets off the ground.

#### (President, continued from page 49)

Association of Planetaria conference in Vitoria, Brazil, about which I also hope there will be plenty to report. I have been very keen to expand the horizons of the IPS, and South America is a part of the world in which I would very much like to see an affiliate. I have had a good deal of communication with Alexandre Cherman in Rio de Janeiro on this matter and I am optimistic that such an affiliate may eventuate in the near future.

As my term as president draws to a close, I'd like to thank all of you for your support. It has been a great pleasure and honour to have been involved with the IPS in this way. I have especially enjoyed working with the other officers: Susan Button, Jon Elvert, Lee Ann Hennig, and Shawn Laatsch. Their work in support of the IPS has been wonderful.

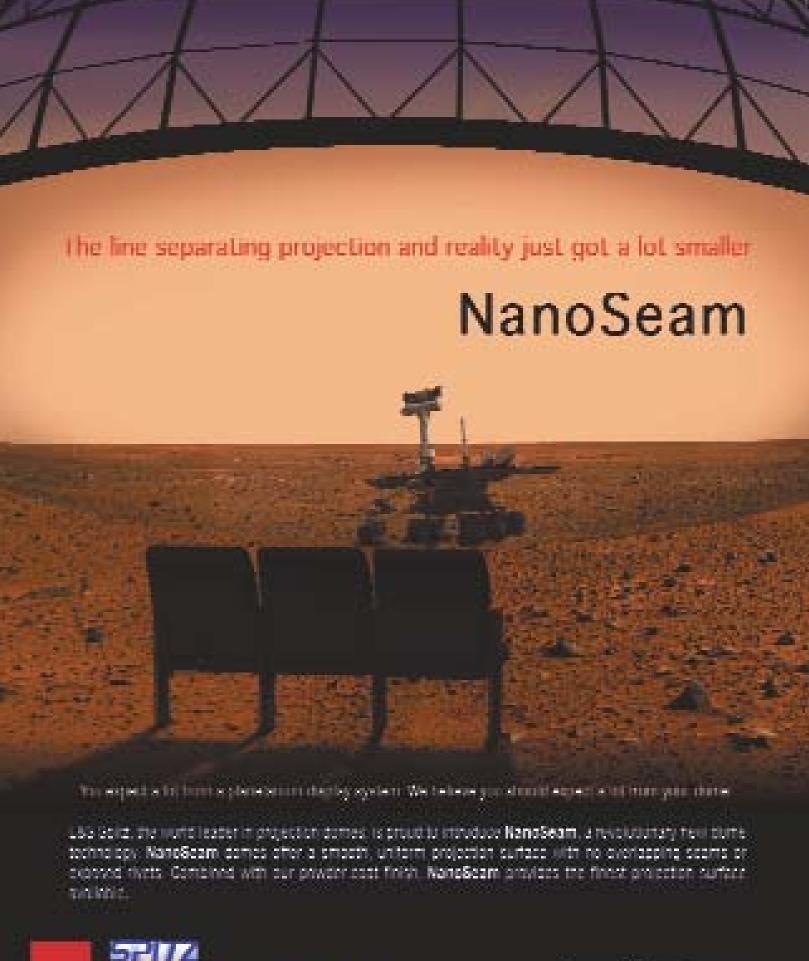
At the time of writing, the election for president-elect had not taken place. Susan, Lee Ann, and Shawn will continue as officers, of course, as I shall in my new role as past

president. Jon's own role as past president is now, however, drawing to a close, bringing to an end his six years as an officer.

Jon has been a magnificent leader and ambassador for our society. In particular, he has done some very fine work with our committees and their structure. He initiated the concept of formal memoranda of understanding between the IPS and other organisations. He also began what I hope is a permanent feature of our Society: an IPS update DVD from the president to be shown at regional meetings and conferences. Several months ago I invited Jon to be the new chair of our Outreach Committee, and am delighted that he accepted this position.

I am sure that I speak for all IPS members in thanking Jon for his wonderful work for the society!

As the New Year begins, Susan Button will become IPS president, and I am looking forward very much to working with her during my term as past president. I wish Susan well and am sure that, through her leadership, the IPS will continue to go from strength to strength.







Digital Theater



## International News



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Go back in time to the 1990 IPS Conference at the Boundless Planetarium in Borlänge, Sweden, where Mariana Back's planetarium version of Harry Martinson's *Aniara* was shown to the international public for the first time. During the final evening, *Aniara* was also the theme of a Space Ballet Performance.

The year after, John Hare, then at Bishop Planetarium in Bradenton, Florida USA, made his own *Aniara* planetarium show with original music by Jon Serrie. As a complement to Hare's show, Aadu Ott and I wrote the essay *Aniara: On a Space Epic and its author*, our essay was later published in *Planetarian* No. 2, 1998.

This fall, a great deal of attention in Sweden has been paid to Martinson, since 12 October was the 50-year anniversary of the original publishing of the *Aniara* cycle of poems. For those readers who would like to make or remake acquaintance with *Aniara*, the 1998 article is available in full at http://www.ips-planetarium.org/planetarian/articles/aniara.html.

The International News column is dependent on contributions from IPS Affiliate Associations all over the world. Many thanks to Agnès Acker, Karl von Ahnen, Bart Benjamin, Ignacio Castro, Pierre Chastenay, Alex Delivorias, Tom Mason, André Milis, Donna Pierce, Loris Ramponi, and Gopinath

Subramanian for your contributions. Special thanks are due to Loris Ramponi, loris@colibrionline.it, who contributes the Calendar of Events. You are welcome back with new reports, and I look forward to contributions from other Associations as well. Upcoming deadlines are 1 January 2007 for Planetarian of March 2006 and 1 April for June 2007.

## Association of Dutch-Speaking Planetariums

At the October meeting of the association of Dutch Speaking Planetariums at the Eise Eisinga Planetarium in Franeker—which houses the oldest planetarium system in the world (1781)—the installation of one of the newest planetarium systems was announced. The Artis Planetarium in Amsterdam is going digital. Two of the latest Sony SR projectors mounted with specially-developed lenses will bring Sky-Skan's Digital Sky 2 into the 20-m dome. This will be the first installment of this projection system in Europe since its first demonstration at the IPS Conference in Melbourne.

The Artis Planetarium will show three fulldome shows: *Origins of Life* by Mirage 3D, Sky-Skan's *Infinity Express* and the children's program *Kaluoka'hina, The Enchanted Reef* by Softmachine. The planetarium also will switch two of their analog programs to digital. For education purposes, the planetarium staff will develop interactive modules for different school groups at different levels.

Artis has a zoo and aquarium, botanical gardens, zoological museum and geological museum in addition to its planetarium. This unique combination meets Artis' primary objective of offering educational material that deals with our planet Earth as a unique place in the Universe to broad segments of the population. The new planetarium will therefore not only provide astronomy in the dome, but also use the new system as a medium to show these different science facets. The whole planetarium facility will get an upgrade, including new exhibition space. To get this all done, the Artis Planetarium will be closed from January until 26 April 2007, which will be the grand opening of the new Planetarium. For more information, go to www.artis.nl/main.php?pagina=paginas/t/pl anetarium or contact Michel Hommel, hommel@artis.nl.

Beisbroek Planetarium in Bruges, Belgium, had the première of its newest show early in July 2006. The show, *Op reis met de sterren* (*Voyage with Stars*), tells how early explorers such as Vasco da Gama and Captain Cook, used the movements of the heavens to find their way across oceans, and how the newest

explorers, like the Hubble Space Telescope and Hipparchos, are mapping the stars. Plenty of time is offered to visitors to enjoy the Zeiss ZKPR/B starry sky. Since the reopening of the planetarium in March 2002, ten shows have been produced, eight of which are still regularly shown. For information, go to www.beisbroek.be or contact Eddy Pirotte, info@beisbroek.be.

The Europlanetarium in Genk, Belgium, is being transformed to serve as the gateway to Hoge Kempen, the new national park. The entire building is being facelifted. Office and other spaces will get a complete new look. Changes can be witnessed on a daily basis in and around the Europlanetarium. For more information, go to www.europlanetarium.be or contact Chris Janssen, chris@europlanetarium.com



Location of the 2006 ADSP members. Courtesy of the Brussels Planetarium, Gert Smet

After a successful event in 2005, the European Commission again supported European Researchers' Night, which offered thirty events in 21 European countries, all held on 22 September 2006. These special events gave the general public, young and old, interested in science or just wanting to find out more, the opportunity to find out about the fun of science. In Brussels, the planetarium of the Royal Observatory of Belgium gave the public the opportunity to talk with scientists about their research and its influence on every day life. Science@work initiated little experiments with children, like build and launch your own rocket, make moon craters, and find the right con-

Outdoors, there was a baseball-type game called "Play with the universe," where the

Ville/Location	Diameter	Opening equipment		New Equipment	
	(m)	year	System	year	Current system
Paris, la Villette	21	1986	OM* (S)	2006	D* 6 VP (RSA)
Pleumeur-Bodou	20	1988	OM (Z)	1998	D 6 VP
Paris, Palais Découverte	15	1937	OM (Z)	1997	OM (Z)
Toulouse	15	1997	D fisheye vectoriel (D)	2005	
Vaulx en Velin	15	1995	D fisheye vectoriel (D)	2006	D 6VP (D)
Montpellier	15	2002	D fisheye vectoriel (D)		+ D 6 VP (D)
Rennes	14	2006	D6VP (SS)		
Villeneuve d'Ascq	14	1996	OM (RSA)		
Poitiers	12	1992	OM (S)		
St Etienne	12	1997	OM (RSA)	2002	D 6 VP (RSA)
La Hague	10	1999	OM (Z)		
Epinal	10	2002	OM (RSA)		
Dijon	10	2005	OM (RSA)		
Cappelle la Grande	9	1989	OM (RSA)		
Le Bourget	8,2	1984	OM (Z)	2000	OM (RSA)
Nantes	8	1981	OM (Z)	2005	D 5 VP (RSA)
Nîmes	8	1982	OM (Z)		
Strasbourg	8	1982	OM (S)		
Nançay	7	1997	OM (RSA)		
Reims	6	1979	OM (Z)		
Châtellerault	6	1991	OM (jide)		
Marseille	6	2001	OM (RSA)	2005	D fisheye coul (d)
Montredon Labessonnié	5,4	1993	OM (G)		
Aix-en-Provence	5	2002	OM (RSA)		
Belfort	5	1982	OM (G)		
Bourbon Lancy	5	1993	OM (G)		

public had to traverse the universe by answering questions. In the dome, a futuristic "Space Weather" report was presented, explaining how events on Earth are influenced by the space weather. Links: http://ec.europa.eu/research/researchersineurope/events/event\_2216\_en.htm, and www.nachtvandeonderzoekers.be. For further information, go to www.planetarium.be or contact André Milis, andre.milis@oma.be.

In the Planetarium Ridderkerk, Rotterdam, The Netherlands, a new Mirage 3D show will have its world première on 13 January 2007. On 13 January, the observatory will be opened as well. The observatory's 4-m dome will be equipped with a 15-cm Zeiss telescope and a 50-cm (20 inch) Newtonian telescope. The dome is "carried" by statues of the four seasons, and circled by bronze statues of Albert Einstein, Isaac Newton, Christiaan Huygens, and Carl Zeiss. Inside the building

are statues of Galileo, Kepler, Nicolas Copernicus, Tycho Brahe and Edwin Hubble. For information, go to www.planetariumrotterdam.nl or contact Ad Los, alr@hetnet.nl.

## Association of French-Speaking Planetariums

A new training project started in January 2006 is going well, the Association of French-Speaking Planetarium reports. After a series of lectures in Strasbourg and Paris, the 12 participants worked during five nights in July at the 0.8-m, 1.2-m and 1.5-m telescopes of the Haute-Provence Observatory, where they learned the practice of professional astronomical tools (spectrophotometry and digital images analysis), improving their knowledge of emission-line objects. See also www.obspm.fr/~webufe/beatep. (Picture on page 60)

During the 22nd Colloquium of French

Advance in digital planetariums in (basically) France. Table by Lionel Ruiz and Daniel Audeon.

Key to System:
OM=optomecanic
D=digital
Z=Zeiss
S=Spitz
SS=Sky-Skan
RSA=RSAcosmos
G=GOTO
D=Digistar/Evans&Sutherland
d=Digitalis

Speaking Planetariums, a forum focused on the strong advances in digital planetariums the past few years (see the table by Lionel Ruiz and Daniel Audeon). Two major problems were identified: (1) The production of immersive video shows is very expensive and time consuming, so it seems interesting for well-equipped digital theatres to produce high-quality shows for distribution to interested planetariums at a relatively low cost. A working group was created in this perspective (Toulouse, Saint-Etienne, Bruxelles), lead by Jean-Philippe Mercier, director of the Montpellier Planetarium, with the distribution service being done by APLF.

(2) Technology improvement is quickly increasing for digital tools, but is stationary for classical optical instruments, despite the fact that most people agree that optical projection allows for the highest quality of stars (contrast, brightness and resolution of the stellar images). This is a problem for those projecting to build a new planetarium and want a very nice sky projection; it is very difficult to find a good and not too expensive solution. French speaking planetarians are waiting for an *optical* projector with *digital* environment, a mixed solution built together by two companies each having a specific expertise.

## Association of Mexican Planetariums

The XXXV AMPAC Annual Meeting was set to be held in November at the Arcadio Poveda Ricalde Planetarium in Merida, Yucatan. New planetariums are being considered as part of major municipal works in the cities of Celaya, Guanajuato, and Tapachula, Chiapas; time will tell if these enterprises are given the necessary support.

At the time of writing, the University of Sonora, DIF-US astronomy area, was organizing an observation camp for the solar transit of Mercury on 8 November with most of Sonora's planetariums participating by live telecast via internet. The DIF-US has also created a special document in Spanish for interested astronomy groups and planetariums titled *Nuestro Sistema Solar: Un Nuevo Concepto para Educadores (Our Solar System: A New Concept for Educators).* This document is free of charge and can be accessed at http://cosmos.astrouson.mx/Educación/constell/ElSistemaSolar.pdf

## British Associations of Planetariums

Finally, after six years of closure, the world-famous Armagh Planetarium reopened its doors in August 2006 after a major renovation program. Armagh is known throughout the industry for being the first planetarium to successfully integrate video imagery into star shows. The new Evans and Sutherland Digistar 3 projector sees this technology come of age with its reopening. Armagh broke all previous monthly attendance records in its 38-year history, achieving almost 17,000 visitors, which is over 1% of Northern Ireland's population, within the first four weeks! Other exciting news is that Armagh Planetarium has been selected to develop the new



The exterior of the new Peter Harrison Planetarium with bronze cladding in place. Courtesy of National Maritime Museum.

Northern Ireland Space Office (NISO). Armagh Planetarium's business manager, Robert Hill, was chosen by Yorkshire Forward/Space Connections to write and design space science and astronomy curriculum content for the Curriculum Council **Education Authority** (CCEA) of Northern Ireland.

Further evidence of Armagh's return to form was its recent success at the annual Digistar Users' Group conference held at Evans & Sutherland's

headquarters in Salt Lake City in September 2006. Digital Theatre Manager Julie Thompson won first place in the Digistar 3 demonstration category. This is the second time that Thompson has taken first prize in this contest for work produced at Armagh Planetarium. (For more DUG results, see page 70)

After being open only nine months, Thinktank's small 70-seat planetarium passed the 50,000 visitor mark in mid-September 2006. Presenter-led shows, delivered from the front of the theatre, continue to elicit the most positive visitor feedback. In August 2006, the UK Visitor Attraction Quality Assurance Service reported: "The planetarium, with its personal style of presentation instead of the normal audio style, was excellent both in its overall presentation and the degree of interpretation provided to meet the needs of a very mixed audience in terms of ages and interest levels. The fact that the presenter was in full control of the displays and could rerun and fast forward if needed to emphasize links and answer questions, was a very strong feature. The short handout leaflet available at the end also summarized the key seasonal features mentioned. Overall, this was an excellent experience in its own right as a standalone feature and greatly added to the overall memorability of the Thinktank experience."

Construction of the new Peter Harrison Planetarium at the Royal Observatory, Greenwich is nearing completion. After overcoming some novel engineering challenges, a giant set of bronze cladding plates were lowered and welded into position this summer. The new 115-seat facility will have state-of-the-art projection equipment and commitment to live astronomy presenta-



The participants in this summer's telescope training project in France in front of the 2-m telescope of the Observatoire de Haute-Provence. Photo Daniel Audéon, Nantes

tions. Most of it is below ground level, apart from a cone that is visible from within the observatory grounds. Former Senior Astronomer Dr. Robin Catchpole chose the shape, which is aligned with the celestial north pole, equator, and zenith. When the planetarium opens in May 2007 as part of the £15 million Time and Space Project, it will be London's largest centre dedicated to astronomy education and outreach.

## Canadian Association of Science Centres

The Montréal Planetarium is still awaiting a decision by the provincial and federal governments regarding the funding of its project to relocate the facility near Montréal's Olympic Stadium, Biodôme, Botanical Garden, and Insectarium, which are all in the east end of the city. The new building's functional and technical program is also being revised to ensure that it meets the needs of a state-of-the-art full-dome video planetarium. Meanwhile, the planetarium was in the midst of preparing a new show, The Exotic Universe, set to open in November. Black holes, quasars, gamma ray bursts, supernovae-our universe is full of objects with surprising and sometimes unsettling properties. The Exotic Universe, written and produced by Louie Bernstein, will help visitors discover an unexpected cosmos. The show is designed for knowledgeable teenage (12 years and older) and adult audiences. For information, contact Pierre Chastenay at chastenay@astro.umontreal.ca.

The Planetarium at the Manitoba Museum in Winnipeg continues to run the popular *Is Anybody Out There?* show, collaboratively produced by Canada's planetari-

um community (see story on page 16). Also in production is a new show about Pluto and the outer solar system, scheduled to open in early 2007. An exhibit and show to celebrate the 50th anniversary of the first artificial satellite—Sputnik 1—is in production for the summer and fall of 2007. For info, contact Scott Young at scyoung@manitobamuse-um.ca.

In October, the TELUS World of Science in Calgary opened a new wing of the science centre featuring a "Creative Kids Museum." In the new gallery the emphasis is on handson exhibits and activities with the theme of arts and creativity. With an already loyal audience of kids and families at the Calgary facility, this new attraction is bound to boost attendance even further, up from what has already proven to be record high levels in the past two to three years.

In September, Calgary's Discovery Dome theatre received an upgraded IWERKS projector head to replace the aging 8 perf/70mm Pioneer film projector that has served the theatre well for ten years. Despite the prospect of all-dome video projection, 8/70 films remain the main fare in the Discovery Dome and will likely continue to be so for another three to four years at least, until an immersive video system is installed that can be fed with a good supply of titles to serve an audience hungry for new shows and changing programs. With the recent closure of one of the city's IMAX theatres (and the minimal schedule of true IMAX films at the city's other commercial theatre), the Discovery Dome has become Calgary's only venue for screening giant-screen films. However, planetarium shows continue to be offered, most notably the recent nationally-produced Is Anybody Out There? and a newly-updated and refreshed version of the perennial children's favourite, In My Backyard, originally produced in Calgary in the early 1990s. For information, contact Alan Dyer at alan.dyer@calgaryscience.ca.

Current show production activity at the H.R. MacMillan Planetarium in Vancouver is centered on two shows for the youngest audiences. Little Dippers, a show which was initially developed in the 1990's, has been upgraded to conform to the needs of the new school curriculum. The program introduces the simple concepts of orbits and planetary rotation. Children are shown how Earth travels around the Sun to make up a year, as well as how the Earth's rotation makes for the daylight and night-time portions of the day. The program then takes young children on a tour through the night sky, pointing out the major constellations, the Big and Little dippers, and the North Star. On the public show side, "Harold the Talking Star Projector" entertains both children and

their parents in Stars for Starters. The program takes the audience on a trip through the solar system, starting with a stop on Venus (where it is so hot that all of the popcorn Harold brought along in the spaceship pops to fill up the entire planetarium dome). The program ends with a landing on Pluto. Research and development has begun on a new public planetarium show on Native Sky Lore. Assisting in the production of this show is Aboriginal Liaison and Education Coordinator Margaret Grenier. The daughter of the chief of the Gitksan House of Dakhumhast, Margaret is the artistic director of the Dancers of Damelahamid, who have the goal of revising and furthering the crosscultural acceptance of their heritage within the greater community, and fostering a greater understanding of the richness of the First Nations culture. For information, contact: Erik Koelemeyer at ekoeleme@hrmacmillanspacecentre.com.



The lid goes onto the planetarium at the College of San Mateo. The new hybrid GOTO Chronos/ E&S D3SP2 should be installed soon. Courtesy of Darryl Stanford. Story on page 63.

## **European/Mediterranean Planetarium Association**

At the end of October 2006, the planetarium of the Thessaloniki Science Center and Technology Museum will complete its second year of operation since its inauguration, and already has established a great reputation as a primary attraction in the dissemination of science and technology in northern Greece. The staff there has just finished a show titled *A Journey to the Stars*, their first in-house planetarium show. This 10-minute, real time show guides its viewers to the most

important constellations that adorn the night sky, highlighting the myths behind their names, and presenting their main stars as well as some of the most spectacular deep sky objects they contain. This production is intended to be a daily introduction before the main show, which, as of the beginning of October, includes Denver's production *Black Holes: the Other Side of Infinity*.

The celebrations for the 50th Anniversary of the Eugenides Foundation continues at full swing. In October 2006 the New Eugenides Planetarium in Athens released its own version of Black Holes, along with an enrichment guide. This show uncovers the life-and-death activities governing the formation of these enigmatic objects that lurk in space, starting in the nuclear furnaces of giant stars to their eventual collapse and destruction under their own gravity, thus making some of the most violent phenomena that have shaped our universe. In the process, the latest information that present-day science has uncovered about these extreme phenomena is examined, as well as the various ways that we can detect their hidden

Also at the Eugenides Foundation in Athens, the European Science Communication Network of 17 Universities ESConet conducted a workshop in September to train young planetary researchers to communicate their science. Some trainees explored the possibility of using a planetarium for presenting current research, and they did it so well that Planetarium Director Dionysios Simopoulos offered them employment right then!

### **Great Lakes Planetarium Association**

Illinois. Stephanie Gove has been appointed as the new director of the Waubonsie Valley High School Planetarium, part of the Indian Prairie Community School District in Aurora, Illinois. Gove is a recent graduate of Bradley University and Peoria's Lakeview Museum Planetarium.

This fall, the William M. Staerkel Planetarium at Parkland College in Champaign presented their own productions of *Autumn Prairie Skies* and *Stellar Extremes*. In December, the planetarium staff will team up with two members of the local storytelling guild for an hour of storytelling under the stars. The staff also plans to bring back their five week *Backyard Astronomy* workshop and add a new one that provides helpful hints for a science fair project.

The Lakeview Museum Planetarium held its 12th annual Interplanetary Bicycle Ride in August. This year, 150 space travelers journeyed between the planets in Peoria's community solar system. Over 2,300 riders have

participated in this annual ride since it first began.

At the Strickler Planetarium on the campus of Olivet Nazarene University in Bourbonnais, Supernova 2005cs was observed during the summer by student worker Ryan Alexander. Alexander was awarded a research grant to observe the apparent magnitude of this supernova in M51. This research was a continuation of his research from last summer, when the supernova was first discovered.

The Cernan Earth and Space Center on the campus of Triton College in River Grove continues to offer its *Skywatcher's Guide* mini-show series paired with its current Earth and sky show. For children, the Cernan Center will bring back its own *Zip! Zoom! Whiz!* program, while laser audiences now enjoy its many laser light shows rendered by a new laser tube.

**Indiana**. Dayle Brown received a grant from the Indiana Arts Commission (IAC) to write/illustrate/publish the third book in the series, *Skylore from Planet Earth, Stories from Around the World...Milky Way.* It is due for completion in the summer of 2007.

Alan Pareis, Director of the E.C. Schouweiler Memorial Planetarium at the University of St. Francis in Fort Wayne, attended the 2006 Contemporary Laboratory Experiences in Astronomy (CLEA) workshop at Gettysburg College and the National Radio Astronomy Observatory in Green Bank, West Virginia. Targeted to college astronomy instructors, CLEA is an annual program developed and operated by Gettysburg College in partnership with the National Science Foundation.

Michigan. The Cranbrook Institute of Science Planetarium in Bloomfield Hills is updating their existing programs to fit the capabilities of their new Digistar 3. In November, they presented their first inhouse Digistar 3 production, a holiday-themed entertainment show titled *Holiday Magic*. In October, Cranbrook welcomed Vatican astronomer Brother Guy Consolmagno, who discussed the ramifications of the IAU's decision on Pluto's status. The Henry Ford Community College in Dearborn recently ran an updated version of their fall star talk *The Road Not Taken*.

This fall, Abrams Planetarium in East Lansing brought back the classic show *The Last Question*, based on the story by Isaac Asimov. The show returned for the 50th anniversary of the publishing of the original short story. The Kingman Museum in Battle Creek finished its first phase of renovations and has begun to remodel the planetarium by moving their geology exhibit into a new exhibit area. The staff is also working to convert several of their old shows to their

Digistar II system.

Fall programming at the Kalamazoo Valley Museum Planetarium included ASI: Baseline. a locally produced show that explores the cosmic distance ladder to determine the location of a star that was blown away. The museum's temporary exhibit Brain will be supplemented with the planetarium show Journey Into the Living Cell.

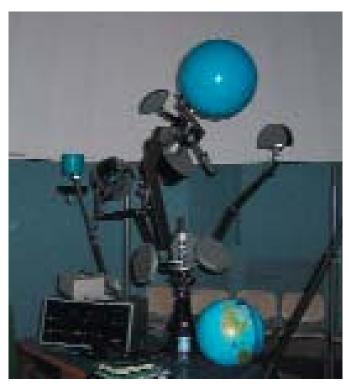
Sadly, this is the last update for the Ensign Planetarium at the Crestwood School District, Dearborn Heights. The glue and the glitter were still drying from two funfilled weeks of Astro Camp when director Carrie Zaitz closed the doors for the last

time—at least for now. Zaitz will return to the classroom to earn her teaching certification.

A historic change in governance came to the Public Museum of Grand Rapids and its Roger B. Chaffee Planetarium on July 1, when the 150-year-old institution became a semi-independent, non-profit cultural institution rather than a division of the City of Grand Rapids. The city retains ownership of the buildings, its furnishings, and all of the historic collections, but the museum will now be run by an independent board charged with overseeing operations and securing the required funding. The staff of the Dassault Systèmes Planetarium in Detroit is producing their next show kit, which is based on the book Bad Astronomy by Dr. Philip Plait. It will explore topics such as UFOs, astrology, the Apollo moon hoax, and alien abductions. Staff members John Potts and John Schroer continue to write and present a series of Excellent Experiments for Detroit's PBS-TV affiliate. The fall observing season began with the 10th Annual Astronomy on the Beach, a large public star party sponsored by the Dassault and Cranbrook planetariums and all seven of Southeastern Michigan's amateur astronomy

#### Italian Planetaria's Friends Association

Rome Planetarium and the National Association of Science Museum organized a



The Galileo planetarium of National Park Foreste Casentinesi. Photo by Gruppo Astrofili Aretini.

workshop about new planetarium activities in Italy in September. The organizing committee included Gabriele Catanzaro, Giangiacomo Gandolfi, Stefano Giovanardi, and Gianluca Masi, Rome Planetarium; Attilio Ferrari, ApritiCielo Planetarium, Turin University; Paola Rossi, Turin Astronomical Observatory/INAF; and Vincenzo Vomero, Rome Planetarium and Science museums of Rome municipality. More information from www2.comune. roma.it/planetario/workshop.htm.

The XXI National Meeting of Italian planetariums was held in October in Ravenna. During the meeting a number of issues were addressed: problems concerning the management of planetariums by Vittorio Mascellani, Modena Planetarium; experiences about the teaching of astronomy by Francesco Moser, Trento Natural Science Museum, Angela Turricchia, Bologna Planetarium, and Alessandra Zanazzi, City of Science, Naples; and news about Milan Planetarium and a report on the IPS Conference in Melbourne by Fabio Peri. Loris Ramponi presented a report on the French planetarium meeting and the international calendar of planetarium events, and a report from the Rome workshop was presented by Vincenzo Vomero, Planetarium and Astronomy Museum of Rome.

Other planetarium experiences were described by Marco Cattelan, Museum of Sky and Earth; S.G. Persiceto and Francesca Manenti, Planetarium of Natural History of



Iceland's first planetarium and its owner Snævarr Guðmundsson. Photo by Heiða Helgadóttir.

Livorno; and Eleonora Sani, Arcetri Florence Planetarium. An open discussion was coordinated by Mario Cavedon, Franco Gabici and Gianluca Ranzini. Among the manufacturers, Christophe Bertier, St. Etienne, France presented the RSA new technologies for planetariums and Glenn Smith, Sky-Skan, presented the Definiti Twin Projector System.

The Italian planetarium model Galileo, for many years used inside the famous Museum



Lars Broman with the IPS Service Award that he was given during IPS'2006 in Melbourne. Photo by John Hare

of History of Science of Florence, has been donated to the national park of Foreste Casentinesi Monte Falterona and Campigna in Arezzo. It is the only planetarium in Italy managed by a national park, aided with collaboration with the amateur astronomer group of Arezzo. Italian planetarium Galileo is a manual model, built in the past in Florence and produced mainly for nautical

schools. It continues to be used in many Italian cities. (Picture, page 62)

#### Nordic Planetarium Association

As was mentioned in this column in the September issue of the *Planetarian*, Iceland has its first planetarium. The owner of this mobile planetarium is Snævarr Guðmundsson, an am at eur

astronomer and astrophotographer, Icelandic mountain guide, writer, and photographer. Some of his beautiful works can be seen on his website www.snaevarr.com. His first book published was about the highest mountain region in Iceland, Oraefajokull, and explains some historical remarks of exploration and mountaineering on the Iceland's highest volcano and its glaciers. His second book focused on the night sky, stargazing, and telescopic observation, from northern latitudes like Iceland.

The planetarium consists of a Digital Starlab system and a Go-Dome. Guðmundsson says that it is a big personal financial risk to do this, but is still acceptable. His goal is to travel between elementary and high schools and give lectures to children, teenagers, and everybody else interested in the night sky and the wonders there. He plans to go all around the island, to every school or group that requests such visits. Secondly, he will give lectures in Reykjavik Zoo & Family Park, which hosts a science center for children and adults. There he plans to give talks about the night sky, constellations, and planets, and to demonstrate how to observe them and where.

Only about 300,000 people live in Iceland. A stationary planetarium has been planned there for more than two decades, but has never been realized.

IPS council has decided once more to give two scholarships from Armand Spitz Fund for Planetarium Education to two science communication master students, to be awarded in 2007. This year, one student has so far received a scholarship, Yang Yu from China. Another student will be awarded the second 2006 scholarship later in the fall. Yu's preliminary results from this project appear in a story on page 38.

I had the honor of being one of four planetarians who were given the prestigious IPS Service Award. I was much honored and also was very pleased that many colleagues afterwards congratulated me for the award.

#### **Pacific Planetarium Association**

There has been, and still is, a lot of remodeling going on in the Pacific Planetarium Association region. A number of facilities have reopened, but among the facilities still closed are two of the largest planetariums: the Morrison in San Francisco and the Griffith in Los Angeles (although the Griffith is scheduled to re-open very soon). Two slightly smaller facilities at De Anza College and the College of San Mateo also remain closed.

At the De Anza College, Karl von Ahnen states that the planetarium project is about mid-way to completion. The floor is back together with a new elevator pit. A new light-lock wall and projection booth walls are in place, but there is no projection dome. On the outside, the biggest change has been the exterior dome roof. Instead of a faded, peeling red, it is now a deep blue. (See picture on page 61)

Alan Gould reports that Lawrence Hall of Science in Berkeley, California acquired a two projector Digital Sky full-dome system from Sky-Skan this past August. They are busily mastering the system and adapting audience participation programs to utilize the full dome system.

If your planetarium or museum is doing or planning to do astronomy programs that involve families, you may want to check out the materials and ideas developed by the Family ASTRO project at the non-profit Astronomical Society of the Pacific. Produced with a grant from the National Science Foundation over a period of four years, the materials are first tested by selected groups of teachers and astronomers who work with them. They are available to anyone in the astronomy education field. See the web site at www.astrosociety.org/education/family.htm.

#### **Planetarium Society of India**

The President of the Planetarium Society of India, Prof. R. Subramanian, attended the Melbourne Conference of the IPS. In his report to members of PSI he related that the Melbourne conference was a great success.

A series of lectures and talks has been conducted at the M.P.Birla Planetarium in Kolkatta. Topics included solar and lunar eclipses and the reorganization of the solar system. The Secretary of PSI, Prof. Gopinath Subramanian, visited the office of the Thai Astronomical Society in Bangkok and briefed them on activities of the IPS. The Society had just conducted a nationwide quiz on astronomy and has brought out an impressive book that has Thai translations for most astronomical terms.



Students at the Ratchaborikanukroh School camp prepare to launch their rocket. In the background in red under the shade of the umbrella is Ajarn Supapan, Head of the English program. Photo by Ms. Pay.

The Ratchaborikanukroh School, where Subramanian works as a science faculty member, has conducted a two-day camp at the Burachat Army Base in Khao Krued in the Ratchaburi province. Students had opportunities at rock climbing and shooting exercises, and were exposed to the sciences and many questions related to astronomy.

One among the various activities was making their own rockets. Students created colorful rockets from soft-drink bottles. These plastic bottles were filled with some water and then by air using an air-pump until the air pressure inside increased substantially. A latch was released and the rocket propelled in the air much to the delight of the students.

## Southwestern Association of Planetariums

In September, 200 SWAP delegates at the Western Alliance of Planetariums Conference in Lincoln, Nebraska, elected for their new board the following: as president, Donna C. Pierce, Highland Park Planetarium, Dallas, Texas, dc Pierce@msn.com; as vicepresident, Michael Hibbs, Tarleton State University, Stephenville, Texas, hibbs@tarleton.edu; as secretary/treasurer, Jim McConnell, Richardson Independent School District Planetarium, Dallas, Texas, jim.mcconnell@risd.org; as IPS representative, Tony Butterfield, Houston Museum of Natural Science, tbutterfield@hmns.org; and, as members-at-large, Chuck Rau, Central Texas College Planetarium, Killeen, Texas, chuck.rau@ctcd.edu and Gerardo Perez, Texas A&M International University, Laredo, Texas, gaperez@tamiu.edu. Wilgus Burton, Garland Independent School District Planetarium, Garland, Texas, was named as associate editor of the Great Western Observer (wilgusb@earthlink.net).

#### Planetarians' Calendar of Events

#### 2007

- 18 March. **International Day of Planetariums**. www.planetaritaliani.it
- May. Meeting of Association of French-Speaking Planetariums (APLF), Marseille, Aix en Provence, St. Michel l'Observatoire, France. aplf@astro.u-strasbg.fr, www.aplf-planetariums.org
- 31 May-2 June. European collaborative for science, industry and technology exhibitions (ECSITE) Annual Conference in Lisbon, Portugal. www.ecsite.net
- 20-22 September. Western Alliance Conference (all planetariums west of the Mississippi River), Fairbanks, Alaska. Contact: Gail Chaid chaidg@esuhsd.org
- 9-13 October. Triple Conjunction Planetarium Conference with the Mid-Atlantic Planetarium Society (MAPS), South Eastern Planetarium Association (SEPA), and Great Lakes Planetarium Association (GLPA). Host: Benedum Planetarium, Benedum Natural Science Center, Oglebay Resort, Wheeling, West Virginia USA. Contact: Steve Mitch,

- smitch@oglebay-resort.com, www.oglebay-resort.com/goodzoo/planetarium htm
- 13-16 October. Association of Science-Technology Centers (ASTC) Annual Conference, California Science Center, Los Angeles, California, USA. www.astc.org

#### 2008

- January. Nordic Planetarium Conference, Jaermuseet, Stavanger, Norway. Host Ivar Nakken. ivar.nakken@mail.nu.
- 15-20 June. **19th International Planetarium Society Conference**, Adler Planetarium, Chicago.
- 15-19 June. 5th Science Centre World Congress, Toronto, Ontario, Canada.
- 22-26 July, Southeastern Planetarium Association (SEPA) annual conference, The Lafayette Natural History Museum & Planetarium, Lafayette, Louisianna, USA. Contact: dhostetter@lafayette gov.net.
- 18-21 October. Association of Science-Technology Centers (ASTC) Annual

Conference, The Franklin Institute, Philadelphia, Pennsylvania, USA. www.astc.org

#### Deadlines for "A Week in Italy"

- 31 December 2006, planetarians from the Southern Hemisphere
- 15 April 2007, planetarians from the United States
- 31 August 2007, planetarians from France
- 30 September 2007, planetarians from Spain For more information on the "Week in Italy, go to:
  - www.astrofilibresciani.it/Planetari/ Week\_in\_Italy/-Week\_Italy.htm

#### **IPS Scriptwriting Contest**

Eugenides Foundation Scriptwriting Contest; for information about the next deadline, contact stidey@hotmail.com

For corrections and new informatio for the Calendar of Events, please send a message to Loris Ramponi at info@serafin ozani.it ☆

#### DIGITAL PLANETARIUM, THE SHINING STAR OF HARTNELL COLLEGE

When the J. Frederic Ching Planetarium at Hartnell College in Salinas, California, decided to replace their 40 year old Spitz A3P with a Konica Minolta Mediaglobe, they considered the risks. Would attendance increase? Would the presentations be more effective? Would the technology remain relevant? Would the audiences love it? "Now after 28 months in operation with the Mediaglobe, the definitive answer is YES!" exclaims Planetarium Director Andy Newton.

Dr. Pimol Moth, a former research Astronomer who now teaches at the College states, "In order to effectively teach Astronomy, it is necessary to have a tool that demonstrates astronomical concepts, displays astronomical photos and movies in a captivating way. My stu-

dents are so much more engaged in astronomy now with the Mediaglobe than they are in a traditional classroom."

"It's hard to believe how the Mediaglobe has created so many diverse uses for the Planetarium", says Newton. "Students in the multi-media program show their works in the Planetarium through the Mediaglobe. For their final exam, the electronic music students compose a piece of music which is played in the Planetarium accompanied by Mediaglobe visuals. We have had jazz concerts, plays, poetry readings, fund raising events, board meetings, corporate and birthday parties among other things in the Planetarium - all which have made it easy to get show sponsorships," said Newton.

The best overall thing for me," says Newton, "is with the Mediaglobe the Planetarium

can practically run itself. For small Planetariums with limited staff this is huge. With the ease of operation, you can bring in and train multiple presenters. This has bought me more time out of the Planetarium to work in developmental areas that benefit the Planetarium, our academic science programs and the College at large."

"Andy has used his extra time to help secure a substantial amount of outside funding from NASA and NSF grants and the private sector that have provided significant opportunities for our students, faculty and institution at large. The choice to go digital with the Mediaglobe played a big role in that," says College President, Edward J. Valeau.



Dr. Pimol Moth (Left) and Andy Newton

In North America Contact: Joanne Young Tel: 407.367.0081 Fax: 407.859.8254

email:joanne@av-imagineering.com



http://konicaminolta.com/kmpl/hard/mediaglobe.html



## Gibbous Gazette



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Planetarium Producer
Henry Buhl, Jr. Planetarium
& Observatory
Carnegie Science Center
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I first saw the announcement a few months ago in the "Fine Arts and Leisure" section of *The New York Times*. **Christie's** in New York, USA was holding an auction of *Star Trek* props and production items from the archives of 40 years of the TV programs and movies. I thought to myself, "How cool would it be to go and at least see the preview display and get a close up look at these genuine relics of sci-fi history?" Needless to say, I didn't fly off to NYC, as I was eyeball deep into the installation of our new **DigitalSky 2** system from **Sky-Skan, Inc.** that opened the week before the auction.

Just imagining the heated volley of the auction paddles left my head in a whirl. I never was a huge "fan" of the show in the "fanatic" sense of the word, but still, I do have a great appreciation for what Gene Roddenberry created with his sci-fi soap opera. I guess that I officially joined the ranks of adoring fans when I first tracked down

Leonard Nimoy to do a voice over for our planetarium show *The Search for Life in the Universe* back in 1999. With all of the various shows out there that have employed voice talent from current and former *Star Trek* actors, I thought that some of you might enjoy a report on the auction. I tried to get as close to the actual auction as possible: the official auction website. With over 4000 items in 1000 lots, I thought I could at least get a glimpse of all of this incredible history.

#### **Not Much Online**

Typically auction houses have at least thumbnail images on their sites and I have appreciated seeing images of the actual items before. To my surprise, none of the lots were pictured and there were only about a dozen promotion images. I guess this was to ensure that the \$60, two-volume printed auction catalog (or a \$500 limited edition catalog with lost footage DVD) would be purchased by fans.

After a world-wide highlights tour, with a live web stream of the event on the **History Channel**'s website, and with online virtual bidding, the auction was set to take the collecting community "Where no one has gone before"! After three days of frenetic finagling, the collection had sold for over twice its estimated value. Wow. I could have kicked myself for not getting in on the action.

My adoration was put in quick context when I picked up a used copy of the small (yet exhaustive) *The Encyclopedia of Guilty* 

Pleasures by Sam Stall, Lou Harry and Julia Spalding. Published in 2004, the encyclopedia has three illustrations on its cover: Leonard Nimov (as Spock), a Big Mac, and Pamela Anderson. The book lists about 1001 other things that are supposed to make us feel guilty for loving them: not only ABBA, Doctor Who. Lava Lamps, Pac-Man, and Walt Disney World, but also shows, laser museum gift shops, superheroes, UFOs, and wax museums. In the words of a popular song, "If loving you is wrong, I don't want to be right!"

Someone who probably understands my love of all things space related is John Sisson (Science Library, University of California at Irvine), who operates a website called Space Art in Children's Books at http://dreamsof space.nfshost.com. John writes that he grew up next door to the Jet Propulsion Lab in Pasadena, California USA back in the 1960's. His website has a great collection of scanned images from some of the books that probably inspired quite a few future space explorers, artists, scientists, and engineers from 1883 to 1974. Click around on John's site and send him an email, jsisson@lib.uci.edu, to let him know if you have a similar collection of space books. I wonder how many of you have similar guilty pleasures. Take some pictures of your space-themed collections (or others) and send them to me and I'll feature them in upcoming editions of the "Gibbous Gazette." But for now let's send...

#### Our Congratulations...

... to **Eugenides Foundation** in Athens, Greece on the occasion of its 50th Anniversary! **The New Eugenides Planetarium** played host to anniversary events and launched its new digital show *Black Holes in Space*. This 40-minute original program explores the life cycle of stars and the processes leading to the formation of these mysterious gravitational enigmas. Founded through the generosity of national benefactor **Eugene Eugenides**, the Eugenides Foundation is an independent organization whose mission is to support the enhance-



**Manos Kitsonas**, Technical Director of the Eugenides Planetarium, pilots the console. Photo courtesy of Steve Savage, Sky-Skan, Inc.

ment of scientific, technological and technical education of Greek youth and to promote science and technology to the wider public. Through its innovative planetarium programs, interactive science exhibits, educational scholarships, awards programs (including the Eugenides Script Writing Contest), extensive publications, and scientific library, the Foundation is set to start a new chapter in its already impressive history!

... to Michael Narlock and wife on the birth of their new baby on September 27, 2006. The new father is head of Astronomy at the Cranbrook Institute of Science Planetarium in Bloomfield Hills, Michigan, USA. Michael's wife started going into labor the evening before he was planning to fly to Salt Lake City for the Digistar User's Group Conference. Mike cancelled his plans to be at DUG, but did submit a demo, "Wizards in Winter," that won second place in the D3 category.

... to the other winners of the Digistar User's Group Demo Awards! (See page 69)

... on the occasion of the **ninth anniversary of the Cassini/Huygens Probes!** This Dome-L post by Ken Brandt of the Robeson Planetarium and Science Center, Lumberton, North Carolina USA nicely sums up the sentiments of a lot of planetarians:

"Going through my show setup this morning, I just realized—October 5 is the ninth anniversary of Cassini "leaving port," departing for Saturn and environs thereabouts! Well done, Cassini and Huygens crew—keep up the fantastic results! And a special planetarian thank you to Bill Gutsch, (Brian Sullivan) and the Ringworld/Ringworld2 team... you have provided us countless (although perhaps Jane Jones, Alice Wessen, and Shannon can give us a ballpark number here) opportunities to 'get the word

out' about the fantastic things a well designed robot can show us. Thanks too, to the CICLOPS Imaging Team, and to Carolyn Porco, for telling the continuing story so well. Of course, thanks also go to the CHARM Telecon team, for the explanations and updates as the new discoveries keep piling on!"

Ken is director of the planetarium, and also is a JPL/NASA Solar System Educator and Ambassador.

#### Our Condolences to...

... the friends and family of John Holmes, who recently passed away. Friend and colleague Ray Worthy posted the news recently on Dome-L: "I have just been informed of the death of my friend John Holmes, who made such wonderful projectors. We in the mobile dome world knew him as a joyful man, full of stories after dinner, but he was more, much more than that. He was a skilled instrument maker and inventor. You, who know about astronomical things will appreciate the level of his accomplishments when I tell you that, at one time, he was the only person who was allowed to dismantle the Harrison chronometers in Greenwich; those wonderful chronometers which solved the problem of the finding of longitude. Yours sadly, Ray Worthy."

... the friends and family of **Gabriel Muñoz** in Mexico. From IPS President Martin George: "Gabriel was a big supporter and Fellow of the IPS and had represented AMPAC—the Association of Mexican Planetariums—on many occasions. He was director of the Morelia Planetarium over a period of over 30 years, and was a former president of the International Planetarium Directors' Congress (IPDC).

"On one occasion, in 2003, I had the pleasure of meeting with Gabriel in Morelia.

Gabriel drove the 300 km from Morelia to Mexico City to collect me, and it was a great pleasure to visit his planetarium and the city itself, especially with Gabriel showing me around. Although the planned 2002 IPS

Conference in Morelia did not come to fruition, Gabriel was always very keen on the possibility of a future IPS Conference or IPS Council meeting being held there one day.

"Gabriel was a good friend of us all and I am sure that many of us have quite fond memories of him.



Gabriel Muñoz

Photo by Martin George

One of mine is that he would always remember to offer me one of his chillies, as he knew I liked them so much! I shall miss him greatly. "

... the friends and family of **Allan Bishop**, who died in August in Westlake, Ohio USA.

From IPS President-Elect Susan Button: "One of our small dome colleagues and past IPS president, **Jeanne Bishop**, tragically and unexpectedly lost her husband Allan to cancer this past August. I am sure many of you know Jeanne well as she is an impressive force in our planetarium world. Allan retired, in 2005, from the NASA Glenn (formerly Lewis) Research Center in Cleveland, Ohio where he worked as an engineer, coordinating research efforts between multiple departments. He was a delightful and kind man. My husband and I will miss talking with him at GLPA meetings. Jeanne's email is: jeanbishop@aol.com."





Deep inside the Star Axis sculpture (left); the Star Axis is aligned (right) with the North Star, Polaris. The sculpture also is created to reveal other Earth/star alignments. Photos courtesy of Charles Ross

... the friends and family of **John Seaton**, who unexpectedly passed away on October 26 at the too early age of 40. His wife, Patty Seaton, is president of the Mid-Atlantic Planetarium Society and director of the H.B. Owens Science Center at Prince George's County Public Schools in Maryland.

From Patty, in a posting on Dome-L: "I know that most of you knew me rather than him, but he was a strong supporter of my work in the field, even though astronomy was not really his interest. He would let me drag him to every planetarium within the vicinity of where we traveled, and gladly watched our young daughter on weekends when I had to work.

"So, if I seem a little on the sad side when I see you next, you will understand why. Thanks for being my friends and family, because I will be leaning on you in the future."

Memorial tributes can be made to the American Diabetes Association (Baltimore Chapter), 3120 Lord Baltimore Drive, Suite 106, Baltimore, Maryland USA 21244.

... The friends and family of William "Bill" Hill, the founding director of the Waubonsie Valley High School Planetarium, in Aurora, Illinois, USA, who died in June. In 1974, Hill became the chair of the science department of the then-new high school, where he supervised the construction and opening of the planetarium.

#### Can You Dig It?

Artist **Charles Ross** has been digging—literally—to create a sculpture that he calls the *Star Axis*. First conceived in 1971, this monumental artwork is being constructed on a mesa in New Mexico, USA. At its outside dimensions, Star Axis will be 11 stories high and 1/10th of a mile across (528 feet, or about 161 meters). Ross

has created what he calls "an architectonic earth/star sculpture (that) is precisely aligned with Earth's axis, which now points toward our North Star, Polaris." Star Axis is a naked eye observatory that offers an intimate experience of how Earth's environment extends into the space of the stars. Though still under construction and generally closed to the public, occasional visitors are allowed onto the site during the summer months. If you are interested in seeing the site, please telephone Lake McTigue, College of Santa Fe Art Department, at (1) 505-473-6500. A \$50 per



Above: Dr. Carolyn Sumner (far right, top) documents the radar mapping of the hyperbolic shape trapped in the Kansas soil. Below: excavation crew loosens the pallasite meteorite on October 15, 2006. Both photos by Tom Casey, Home Run Pictures, and courtesy of the Houston Museum of Natural History



person donation is requested. Donations for Star Axis are being received by the College of Santa Fe, a nonprofit educational organization. They only ask that you give plenty of advance notice and that you be flexible regarding the exact time and day you would like to visit.

When Star Axis is complete, it will be open to the public by reservation. For more information, visit http://www.staraxis.org. Here you can also view some of Charles's solar spectrum light sculptures that he has been commissioned to create for a variety of

architectural spaces since the early 1970's.

#### Digging in Ireland

Humankind has been digging into the Earth for a long time. Visit the website http://www.knowth.com to get a great online tour of some of the Megalithic Passage Tombs of Ireland! There are lots of great images of the tombs and plenty of info to quell your desire for archeoastronomy between trips out into the trenches.

#### **And Digging in Kansas**

As she planned for a new exhibit on comets, meteors, and asteroids, Dr. Carolyn Sumners, senior director of astronomy at the Houston Museum of Natural Science, Houston, Texas, USA wanted to apply the latest scientific techniques to the process of digging up a buried meteorite to maximize the data collected. First she collaborated with the Brenham Meteorite Company to find a suitable meteorite. In a wheat field just east of Greensburg, Kansas, USA Steve Arnold identified a buried metallic object using a custom-designed large loop metal detector, but he had no way to tell if the object was a buried meteorite, tractor part, pipe, or barrel.

Dr. Sumners then asked Dr. Essam Heggy of the Lunar and Planetary **Institute** in Houston to provide techniques for mapping this buried object using ground-penetrating radar. Dr. Heggy's research has focused on the identification of subsurface structures on Earth as he develops and tests a ground-penetrating radar system that may someday be used on Mars. "Although Kansas is not Mars, multiple frequency, polarized and cross-polarized ground-penetrating radar mapping should still identify a foot size iron-rich meteorite buried in loose ground soil," said Heggy.

In October, Dr. Heggy's radar

showed a clear hyperbolic shape, 4 ft (1.2 m) below the surface—the signature of a bulky elliptical object. With multiple-frequency scanning using different radar antennas, he estimated the size and depth of the object and provided the parameters for digging. The museum sent a field team of archeologists and geologists to collect and sample soils and to gather other data buried with

object and provided the parameters for digging. The museum sent a field team of archeologists and geologists to collect and sample soils and to gather other data buried with the rock. After two days of digging, the team revealed a rare meteorite called a pallasite, seen for the first time after being buried for thousands of years.

Stratigraphic layers promise new knowl-





The attendee's of the Spitz Digital Institute on the lawn at Chadd's Ford. Photo courtesy of Spitz Inc.



Top: Largest oriented pallasite on display in the lobby of the CyberDome at Exploration Place. Left: Chirpie flies again in his all new adventures next spring from the CyberDome in Wichita! Both images courtesy Exploration Place

edge on exactly when the meteorite hit Earth; soil compaction conditions may give an indication of its direction of impact. Its shape and external condition may tell how it entered the atmosphere. Organic materials buried under the meteorite may provide additional evidence of the date of impact, and its composition may explain its origin inside an asteroid, perhaps billions of years ago. According to Dr. Sumners, "this meteorite is definitely talking and we are listening carefully!"

#### "Digging" at CyberDome

And since we're digging around in Kansas and it is an IPS conference year, let's visit the site of a previous IPS Conference and check in to see how things are going at the CyberDome at Exploration Place in Wichita! Davin Flateau, director of Theaters and Media Services, is also digging around for someone to buy their Iwerks Turbo Tour motion ride installation, digging his new meteorite exhibit, and digging into their newest children's show production. "We're offering our Iwerks Turbo Tour motion ride

has 24 movable seats in 12, two-seat pods, that's synchronized via a computer to a 70 mm Iwerks Quatro projector that runs special simulator films from Iwerks-Simex. Everything works great, and although Iwerk's support for the actual projector these days is limited, there is still a large library of films out there for these motion rides. We're going to

installation for sale. It

convert that theater into exhibit space.

"We also created an astronomy exhibit gallery in our theater entrance. I've been working with the Brenham Meteorite Company to create a new Kansas meteorite exhibit featuring over 2,500 pounds of meteorites! Five specimens of recently unearthed Brenham meteorites from central Kansas, some never seen by the public before, are on display for viewing—and touching! Featured is the 'main mass,' the current record holder as the world's largest flight-oriented pallasite at over 1,400 pounds. It made a huge international news splash when it was unearthed last year!

"On the show front, we're currently in production on *Chirpie 3*, the third installment of our very popular fulldome Chirpie series for pre-school and kindergarten-aged kids. Chirpie is a mischievous little bird who has taken kids on a tour of the sky, the seasons, and Earth in our first two Chirpie shows.

"In this third show, Chirpie takes his longanticipated trip into outer space, visiting the Moon and planets, making new friends, while trying to keep his tail out of trouble! The third Chirpie show should be complete this spring."

For details, contact Davin at dlateau@ exploration.org.

#### **Continuing Education**

Spitz Inc. recently held its latest **Digital Institute** at the Spitz facility at Chadds Ford,
Pennsylvania, USA. The purpose of the
Digital Institute is to introduce teachers and
planetarians who are new to digital astronomy education a chance to sharpen their
skills. Taking part in instruction included **Herb Koller** and **Pedro Braganca** of **Starry Night** Canada in Toronto; **Phil Sadler**from **Learning Technologies Inc.**; and **John Stoke** and **Dr. Frank Summers** from the **Space Telescope Science Institute's Office of Public Outreach**. Instructors from Spitz include
Joyce Towne, Scott Huggins, and David
Millard.

Over 30 planetarium professionals attended this year's Digital Institute. Dates for next year's program can be obtained from **Scott Huggins**, director of Marketing at shuggins@spitzinc.com.

#### Did you know...

... that **The Coca-Cola Space Science Center** in Columbus, Georgia, USA has obtained exclusive rights to produce the first ever **Dr. Seuss** fulldome planetarium show? The program will be based on the book *There's No Place Like Space*, written by **Tish Rabe** and illustrated faithfully in the style of Dr. Seuss by **Aristides Ruiz**, in which the venerable Cat in the Hat takes Sally and Conrad on an adventurous trip through the solar system. Now in the preproduction stage, Omnisphere Director **Lance Tank ersley** recently asked fulldome planetarium directors and managers to take a short online

survey to get feedback to help in planning this exciting new show. You can email Lance for more details at lance@ccssc.org.

... that the National Oceanic and Atmospheric Administration (part of the US Department of Commerce) has a dramatic teaching tool in their Science On A Sphere® exhibit technology? It's almost like fulldome video in reverse! Science On a Sphere (SOS) is a room-sized, global display system that uses computers and video projectors to display planetary data onto a 6-ft (1.8 m) diameter sphere, like a giant animated globe. NOAA researchers have developed SOS as an educational tool to help illustrate earth system science to people of all ages. Animated images of atmospheric storms, climate change, and ocean temperature can be shown on the sphere in a large display setting, allowing viewers to move around the display.

SOS is available to any institution and is currently in operation at a number of facilities in the United States. NOAA has been using SOS to support educational initiatives, primarily in informal education venues such as science centers and museums. SOS is built from standard hardware components and off-the-shelf PC's, video projectors, wires, and a sphere. When installed in a room, the sphere is suspended from above and surrounded at the corners of the room by four video projectors; all of the display computers are controlled centrally by a fifth computer. Data is pulled from a disk, manipulated, re-projected, and synchronized back onto the sphere.

You can find previews of stills and movies for this product and for your other teaching needs at http://sos.noaa.gov/gallery. For more information about the NOAA Science On a Sphere®, contact William B. Bendel, NOAA Global Systems Division, Boulder, Colorado, USA; phone (1) 303-497-6708; or email Bill at William.B.Bendel@noaa.gov.

... that Marc Taylor from the Andrus Planetarium at the Hudson River Museum in Yonkers, New York USA is looking for some fresh approaches to "Science Gallery" design? How many times have you said, "I love my planetarium lobby!" If this is the case, send your design ideas to Marc at mtaylor@hrm.org, and while you're at it, send some pictures along to me and I'll showcase your exhibit, lobby, or demo ideas right here in print!

... that the astronomy-loving folks at the University of Chicago/Kavli Institute of Cosmological Physics/Adler Planetarium & Astronomy Museum collaboration, COSMUS, has created 3-D side-by-side stereo images and interactives? They are primarily

(See **Gibbous** on page 71)





Left: Anton Vamplew from the Royal Observatory in Greenwich, UK (left) and Greg Andrews from the SciPort Discovery Center in Shreveport, Louisiana USA; Right: Julie Thompson and Dr. Tom Mason from Armagh Plaentarium in Armagh, Ireland, at the DUG conference. All photos by Marty Sisam and courtesy of the Digistar Users Group

#### **Digistar Users Group**

The Digistar Users Group (DUG), an independent group of professionals who own and use Digistar technology, held its annual conference at Evans & Sutherland's facilities in Salt Lake City, Utah USA, in September. More than 70 registered, making this the largest conference in DUG history.

Salt Lake City's Clark Planetarium hosted activities the first evening, presenting their latest full-dome show, *Black Holes*, narrated by John de Lancie of *Star Trek* fame. E&S and Mirage 3D both premiered programs: *Mystery of the Christmas Star*, a full-dome show available for the holiday season, by E&S; and *Origins of Life*, a story of the beginning and development of life on Earth, by Mirage 3D. Starlight Productions closed the evening with a live performance by recording artist Jonathan McEuen, who played guitar and sang to real-time and playback full-dome video perfectly synced to his music.

In addition to demonstrations of cutting-edge technology (including the E&S Laser, the new Sony SXRD, and DLP projectors), the highlight of the conference was the annual DUG Awards. DUG members presented samples of their latest work for both Digistar II and Digistar 3, and the entries are entered into the DUG Library to be available free-of-charge to all members.

Digistar II submissions were: *Santa Snork, George & Oatmeal, etc.* from Jennifer Horvatin from Longway Planetarium in Flint, Michigan USA; *3D Face, Mr. Rogers, etc.* by John French from Abrams Planetarium, Chicago, Illinois USA; *Beyond the Solar System* by Jason Heaton from the Boonshoft Museum of Discovery, Dayton, Ohio USA; and

Haunted Castle by Eric Schreur from the Universal Theater and Planetarium, Kalamazoo, Michigan USA.

Digistar 3 submissions: Awesome Universe & Sack by Piyush Pandey from Nehru Planetarium, Bombay, India; Cosmic Jukebox & Eye Candy by Steve Cooper from the Science Center of Iowa, Des Moines; Armagh Story by Julie Thompson from Armagh Planetarium, Armagh, Ireland; Wizards in Winter & Best Christmas by Michael Narlock

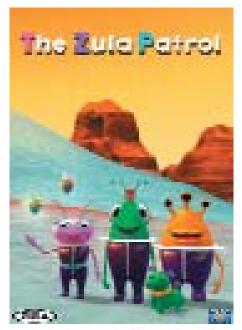


Attendees at the DUG conference in Salt Lake City, Utah USA demonstrate safe solar viewing while looking at the Sun (at sunspots, we hope).

from Cranbrook Institute of Science, Bloomfield Hills, Michigan USA; Floating Constellations & Solstice Suns by Dan Spence from Northern Kentucky University; Highland Heights, Kentucky USA; Nightwalk (Beta Test) by John Zinck from Boonshoft Museum of Discovery; Star Hopping Buttons by Krissie Cook from Santa Barbara Community College, California, USA; Enter the Sandman from Don Harrington, Discovery Center, Amarillo, Texas, USA; and Raising Alexandria & Decoding Maya from Infovision.

The winners were: Julie Thompson, first place in Digistar 3, and Michael Narlock, second; in the Digistar II category, John French took first and Eric Schreur took second.

Seminars throughout the conference were presented by Gary Senn from the University of South Carolina-Aiken; Matt Mascheri from Adler Planetarium; Bruce Thatcher from Starlight Productions; and Michael Daut, Stan Pitcher, Fred Orrell, Boyd Whiting, Kevin Scott, and Lynn Buchanan, all from E&S.



The Zula Patrol will star in their own full dome children's planetarium show next summer! Photo courtesy of Spitz Inc.

(Gibbous, continued from page 70)

designed for the "GeoWall" (see http://geowall.geo.lsa.umich.edu), a science visualization tool for earth science and research. COSMUS also has 2-D movies and interactives. Topics include a fly through of the **Sloan Digital Sky Survey**, surface of Mars, ultra high energy cosmic ray showers, and the black hole at the center of the galaxy, and all can be previewed at http://astro.uchicago.edu/cosmus/proj ects.html. The best part is all visualizations are *free*—COSMUS only asks to be credited.

Stop by their website and take time out to contact **Randy Landsberg**, director of Education and Outreach for the Kavli Institute and the Department of Astronomy & Astrophysics at the University of Chicago, 5640 South Ellis Avenue, Chicago, Illinois USA 60637; phone (1) 773-702-7783; or email him at randy@oddjob.uchicago.edu.

... that the weekend staff at the **New Detroit Science Center's Dassault Systèmes Planetarium** had an unexpected out-of-town planetarian visitor recently? While in the Detroit, Michigan USA area visiting relatives,

Dimitrie Olenici of Suceava Planetarium in Romania, stopped by to catch their new show *The Greatest Wonders of the Universe*. Dimitrie seems to be very interested in pendulum experiments. Visit his website at http://www.allais.info/priorartdocs/olenici. htm.

... that The Zula Patrol-Under the Weather fulldome planetarium show is in development at Spitz, Inc.? The Zula Patrol is a popular animated TV series currently airing on Public Broadcasting Service affiliates around the USA. Spitz Creative Media is working in conjunction with the show's producers, **Zula USA**, to bring the show to a fulldome theater near you. The program is scheduled to premiere next summer at the Adler Planetarium in Chicago, Illinois USA. The show is targeted for younger viewers (pre-kindergarten to third and fourth grade) and their families. The fulldome show will complement a traveling exhibit under development by ThinkWell. For more information on the series, educational outreach activities, museum exhibit and more, visit www.thezulapatrol.com. To learn more about the fulldome project, visit http://www.spitzinc.com/fulldome shows/index.html.

## People (and Equipment and Websites) on the Move

... **Alexandra Barnett** will resign her post as the chief executive officer of the **Cabot** 

Space and Science Center in Oakland, California, USA at the end of 2006. Alex stated personal reasons when she wrote recently of the news to Dome-Ler's. Alex shares that she has found the love of her life and plans to shorten a long commute by joining her husband-to-be closer to his home about 90 minutes away. She plans to stay involved with Cabot, however, as she is deeply committed to current and future

projects that are already underway. Alex has provided the following email addresses so friends and colleagues can stay in touch after the first of next year: alexbarnett@sbcglobal.net. If you have a creative/consulting need, contact her at

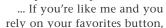
cosmiccreative@yahoo.com.

... Jeffrey L. Smith will retire from the State Museum of Pennsylvania in Harrisburg, Pennsylvania USA after 39 years of service to the museum's Planetarium. Jeff oversaw the installation of a SciDome fulldome planetarium system from Spitz in 2005. Jeff will ease into retirement and would like to keep in touch with other planetarians. You can contact by mail at 351 New Bloomfield Road, Duncannon, Pennsylvania USA 17020 or by email at jsmith@paonline.com.

... BCC Planetarium and Observatory at Brevard Community College in Cocoa, Florida, USA has a treasure chest full of planetarium equipment that it would like to sell. I'm not sure how fast this equipment will get grabbed up, but Chuck Greenwood, planetarium engineer, recently posted the following info at Dome-L: "We now have permission to unload some old stuff. I know there were people interested in our special effectsnow is the time to get them. We've got roughly 65 projectors, with a value in the tens of thousands. We'd be happy to get an average of \$100 each for them." You can look over an online list of the items for sale at http://www.brevardcc.edu/planet/sale. You can contact Chuck if you see something your dome can't live without at GreenwoodC@brevardcc.edu.

... And speaking of vintage planetarium equipment for sale, **John Hare** of **Ash** 

Enterprises has also revealed recently that he has an extensive inventory of used Talent projectors, single-shot slide projectors, and many other used special effects. You can contact his associate Eric Melenbrink, e. m elenbrink @ att.net in the Richmond, Virginia USA office of Ash Enterprises for inventory descriptions and prices.



then you need the following News from the Nessies! **Mark Petersen** reports that the web address "lochness.com" has gone to a site at Loch Ness in Scotland and the new web site for **Loch Ness Productions** is changing to lochnessproductions.com.



Alexandra Barnett

(Editor, continued from page 4)

let's allow them to do its job and move on.

All these questions and changes—just some of the few facing our community—have to be examined under one light, however: education. Isn't that what it comes down to—our ability to teach? We can teach without fulldome, but our ability to do so is

enhanced by this technology. If we can't afford all-dome, we can still teach with the traditional programs—or with just a star projector. If we have the ability to teach—and the capability, no matter how simple or advanced—we're doing our jobs. We're doing this so there will be others to take our places and continue the job of educating children and the public about science in general and

astronomy in particular. We're influencing the children who will become the scientists of the future, who will be making the discoveries that allow technology to grow – so necessary for our world to progress and our society to grow.

Kids will be kids. They'll always be fascinated by the stars. Let's give the stars to them the best way we can. ☆

## Last Light



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

What a wonderful conference! What gracious hosts! What perfect weather! IPS 2006: Under the Southern Skies rates among my top three conferences ever. I'm guessing that many of us read Steve Tidey's description on Dome-L of the jaw-dropping-gorgeous night sky we observed from Heathcote. Add excellent speakers, great ideas from fellow planetarians, generous vendor support and nearmagical new technology, and this was one great meeting. Many thanks to Dr. Tanya Hill and her incredible staff for welcoming us so warmly.

And feeding us so well! Faced with a long table of delicious-looking luncheon, I realized that I didn't know what some of the dishes were. When I asked about it, Andrew Buckingham, just ahead of me in line said, "I shall translate. Salad, salad rolls, meat pies." Thank heaven for helpful colleagues.

At one of the dinners in the historic Pumping Station at Scienceworks, we managed to collect most of the past presidents of the Society (a task akin to herding Schrodinger cats) for a group photograph.

#### Overheard in Melbourne:

During that dark-night-sky tour, Tanya mentioned that the conference planners were not sure about that part of the program. They couldn't believe that 300 people would actually *want* to be walking around outside at night in the dark.

David Malin's opening lecture shared "Images of Science" with us. Terrance Murtaugh later told a story about David's

first night of observing at the Anglo-Australian Observatory, soon after his arrival from England. The sky was clear, the slit was open and Mr. Malin was getting the telescope ready for the observing session. Happening to glance out of the slit, he suddenly noticed huge clouds rising in the sky. In a panic, he rang up the technicians, exclaiming that it was about to rain.

The techs all burst into hysterical laughter. The "clouds" were the Sagittarius region of the Milky Way.

Rob Landis showed some excellent animation sequences featuring the International Space Station during his keynote speech. He noted that the Service Module section of the ISS has the only toilet on station. "So if you dock the Soyuz here, and enter station through this hatch, it really is "first door on the right."

Dr. John Storey talked about Antarctica—not just cold, but cool! There are some research sites on the continent, several of them with the name "dome" followed by a letter designation: Dome A, Dome F, etc. As he was describing the various sites, from the row behind me a voice whispered, "Hey! There's no Dome L!"

When I mentioned that later, Sally Goff

noted that the site letter designation reflects the name of something. Dome F is for Fuji, for example. Sally suggested that Rob travel to Antarctica, and create Dome L for Landis!

Dr. Storey described the ice cores that have been drilled

from the Antarctic ice. Atmospheric nuclear tests show up in those core layers, which he referred to as "site testing with nuclear weapons."

Alexandre Cherman from the Rio de Janeiro Planetarium presented some native Brazilian sky stories. As a PhD physicist, he said, he adopts the "quantum physics" approach to collecting sky stories from native cultures: "The less I interfere, the better it goes."

When he hears of linguists or anthropologists about to travel into the rainforest to visit indigenous peoples, he asks them "to please ask the people about the sky" and he

stays home. "I would not do well in the jungle," he said. "I'm too big, I'm clumsy, and I get hungry often."

There are not many sky stories from people who live in a rainforest. You can't see the sky. There is a lot of knowledge about the seasons, however. There are two, he said: rain, and lots of rain. The river is to your waist or the river is to your neck.

We had a delightful speaker for the conference dinner. Professor Fred Watson is Astronomer-in-Charge of the Anglo-Australian Observatory (AAO) at Siding Spring. (His book *Stargazer—The Life and Times of the Telescope* was reviewed in the March 2006 *Planetarian.*) His talk was titled "Astronomers Behaving Badly," which he began with "Don't worry about turning off your mobile phones. I don't care," and responded to an audience member with "I love being heckled, but: you don't get your dessert until I've finished."

When showing us images of the AAO dome, he pointed to his thinning hair and noted the similarity between the dome and his head. "When the rest of my hair falls out, which will be soon," he said, "I'm going to have a little walkway tattooed round my head."



Presidents past, present and future (left to right) Jim Manning, Thomas Kraupe, Martin George, Jon Elvert, Dale Smith, Martin Ratcliffe, and (front) Susan Button.

Describing images of nebulae: "The hydrogen atoms get excited and when they get excited they do what humans do when they get excited. They glow pink."

Near the end of his talk, he asked David Malin, "Did they offer you a knighthood when you left England, David? They sure never offered me one."

To which David Malin replied, "I got a pair of pajamas."

The conference program book notes that Professor Watson "has an asteroid named after him (5691 Fredwatson), but says that if it hits the Earth it won't be his fault." ☆



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