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Articles

09 Yet Another Scale Model of the Solar System .......... John T. Meader
11 Stars in Their Eyes; Poetry in Their Hearts .......... Jeanne E. Bishop
14 Who Are the Creationists .................................. David Chandler
18 Selecting a Video System ................................ Jefferson L. Hunt
20 Digital Television Techniques and Applications ...... Terence Murtagh

Features

27 Forum: Responsibly Accurate .............................. Lonny Baker
32 Focus on Education: IAU Colloquium 105 ............... Mark S. Sonntag and Mary Kay Hemenway
36 Book Reviews ................................................ Carolyn Collins Petersen
40 Script Section: On Other Worlds With “Weatherman” ...................................................... Jordan Marché II and John Mosley
53 Dr. Krocter ........................................................ Norm Dean
54 Gibbous Gazette ................................................ Donna Pierce
57 Regional Roundup .............................................. Steven Mitch
62 President’s Message .......................................... Terence Murtagh
66 Jane’s Corner ..................................................... Jane G. Hastings
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This summer marks the 20th anniversary of the first moon landing. No other event of our century has marked so profound a change in the way people think about the sky. The moon went from a remote astronomical object studied by astronomers to a world where people walked around and put in a day’s work. Now we knew that the planets would follow—it was only a matter of time before we would visit them all.

Those of us old enough to remember the Apollo 11 moon landing (and not all planetarians are!) are nostalgic when we reflect back on the greatness of the moment. It was certainly the pinnacle of human achievement, and it was a proud moment. We expected everyone to share our elation.

But there were clouds. The Apollo program was criticized as being too expensive and too irrelevant. Social problems needed our attention, we were told. It’s an old argument, and it didn’t end with Apollo; it’s with us still. What price science and exploration, especially when the price tags are high?

Jim Loudon spoke eloquently about the value of such projects. I recently ran across his “Myriads of Other Worlds: The Moon in Perspective,” which is part of Apollo’s Moon, which Jim wrote at the University of Michigan in the early 1970s to supplement George Abell’s Exploration of the Universe. It reminded me that not everyone in 1969 fully shared my joy. As we begin to celebrate Apollo 11’s 20th anniversary, I think it is appropriate to remember the clouds, too, so as to put the mission in full historical context. And, with a few minor adjustments of the numbers, his arguments are entirely valid today against the same criticisms.

The most important, and perhaps least understood, characteristic of scientific research is that its greatest benefits nearly always come about by chance. “Pure” research, carried out for no reason but the satisfaction of curiosity, somehow produces (as accidental byproducts) most of the historic advances in human material progress. Few of them originated from deliberate efforts to bring them about; in most cases, we didn’t know ahead of time that they were even possible.

For example, as Arthur C. Clarke points out, the biggest medical advance of the late Nineteenth Century was x-rays—discovered unexpectedly by physicists studying the behavior of electron beams in vacuum. Polio vaccine was made possible by, among other things, the electron microscope. The laser—itself an unforeseen outcome of supposedly abstract studies in subatomic physics—has turned out to be useful in everything from communications to fusion power to eye surgery. The point is that this sort of thing is the rule, not the exception. Apparently we know so little about the universe, even now, that we make our biggest advances by simply asking as many questions as we can, at random—and seeing what turns up.

All the simple people who want to “spend the money on cancer research instead of going to the moon” don’t seem to understand this, despite the number of spectacular examples in the past. The problem with cancer is that we don’t understand enough of the basic chemistry and physics of life. The clue to a cure is more likely to come from going to the moon, or studying the sex life of the giant squid, or something equally improbable than the kind of narrowly goal-directed program these people seem to have in mind (which would discard any line of inquiry that didn’t seem ahead of time to be “relevant”). Of course, it works both ways. Don’t be surprised if the next big breakthrough in rocket fuel comes from a cancer lab.

Having brought this up, we should also mention those other simple people who apparently think we could solve all our social problems by adding the 1% of the federal budget we spend on spaceflight—all spaceflight, not just Apollo—to the 52% we spend on social programs. We won’t attempt to correct their arithme-
tic—human kind," wrote T.S. Eliot, "cannot stand very much reality"—we'll merely suggest that a nation which, every year, spends a third of a billion dollars on chewing gum might be able to afford both without undue strain. The "priorities" argument is not so much wrong as irrelevant.

If history has given us any guide at all as to what types of research to support, it is only to pick the most radical, the ones farthest removed from what we've already been doing. Space exploration—turning our attention from the single planet that has occupied us for all our history out to the entire rest of the universe—seems to fall into this category; therefore it ought to be worth doing. In our Solar System alone, there are twenty-five bodies 500 miles across or bigger—each as rich and varied as our own, and each different. If we can't find something of value in twenty-five separate worlds, we hardly deserve the label of intelligent species.

If the most important dividends of lunar and planetary exploration are longterm and unforeseeable, the major short-run benefit—to us of this last era of human history in which the entire species is confined to a single planet—is clear. It's to learn more about the earth.

A major problem in understanding the earth has always been that there's only one of it. Imagine that you had seen only one tree in your life. You would not know which of its features were important to understanding it and which were merely accidental. You might think the exact number of its leaves was as important as their green color or the tree's growth rate. If you had a whole forest, preferably with several species, you wouldn't make these mistakes. The value of comparative studies has long been clear in everything from nuclear physics to psychology. Spaceflight gives us the first chance to compare other planets to our own. A study of the similarities and the differences is certain to lead to insights about planets in general, and therefore the earth in particular, that we could never obtain by staying home and devoting all our attention to it. The space program costs the average U.S. citizen slightly less than a pack of cigarettes per week. How much would it be worth if—to take an example of the kind of result we might expect from early planetary exploration—we learned to predict earthquakes?

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The Planetarian, Vol. 18, No. 2, June 1989
Yet Another Scale Model of the Solar System

By John T. Meader
North Starlab Planetarium
4 Osborne Street
Fairfield, Maine 04937

We have all made scale models of the solar system to help students have a more realistic concept of the sizes and distances involved. I have personally used many different models and have always found that, while most students find them to be an eye-opener, there are always a few smug kids who claim to know the concept of correct scale almost a priori, and would consequently gain great pleasure at ridiculing those who obviously weren't born with this knowledge. My feeling, after several encounters with child geniuses of this sort, was that there probably weren't an awful lot of third or fourth graders who really had a good grasp on scale. There must be a better way to impress upon them an accurate scale of our solar system in a way that will truly hit home and make them deal not only with reality, but also with their own misconceptions. The following model is what we came up with and it works better than anything I have ever used.

MATERIALS NEEDED:

1 Beach Ball (preferably yellow or orange)
1 Set of Play-Doh Modelling clay
1 String 13 meters long (40 feet)

PREPARATION:

Take the string and tie a loop about five centimeters (two inches) in diameter in one end (this is where you will place the beach ball sun later on). Then tie an overhand knot at the appropriate distances that each succeeding planet will be from the beach ball sun. Use the following planet scale information chart to tell you how far away from the sun each knot should be tied.

PART 1. SIZE SCALE

HINT: You might want to make two or more model solar systems so that every student can partake.

Assign every student a planet and then give each student a lump of clay more than big enough to make their planet. If you are using Play-Doh, you might want to use appropriate colors (ie. red for Mars, blue for Earth, etc.). Explain that you want them to guess how big their planet would be if the beach ball were the size of the sun. It is best not to have them attempt to make rings for Saturn. Have each student make his planet out of clay according to how big he thinks it should be.

Almost always, everyone's planet will be too big. Once they are done, go through the group and change their planets to the correct size. Correcting the students in this fashion will make the actual scale much more impressive. Every student must then be responsible for not loosing his planet. This isn't necessarily easy, as some planets, like Mercury and Pluto, are only about the size of a grain of sand. I have found that the students with the smallest models usually take great care and pride in their little tiny worlds!

PART 2. DISTANCE SCALE

This part of the model should be done either in the gymnasiun, cafeteria, or outside. In order to make the distance scale workable within a school environment, we found it best to represent distance on a smaller scale than we used with size.* If we had maintained the same scale for distance that we used with size the string would have been 420 meters long rather than 13 meters!

Separate your students into their various solar systems (if you have more than one). Have each student take his clay planet and place it where he thinks the appropriate distance for that planet should be from the beach ball sun. Once each student has placed his planet down where he thinks it belongs, take out the string with the proper distance scale measured out in knots. Then, one at a time, beginning with Mercury and then moving outward, have each student move his planet to its proper position. Again, this makes the students aware that their perspectives are different from reality. The solar system is probably much larger than any of them had guessed.

* The size scale approximates 1 centimeter equaling 140,000 kilometers (1 inch equaling 225,000 miles) while the distance scale is about 32 times smaller with 1 centimeter equaling 4,500,000 kilometers (1 inch equaling approximately 7,000,000 miles).
Once it is laid out to proper scale, I usually discuss the differences between the inner planets and the outer planets, the placement of gaseous planets versus terrestrial planets, and so on. The differences become very obvious.

PART 3. RELATIVE MOTION

Now that your model solar system is laid out to the proper scale, have your students pick up their planets. Tell them to try to walk at their appropriate distances from the sun and to walk at approximately the same speeds around the sun, each in their respective orbits. Which planet goes around first? Once Mercury has made one revolution, have them all stop and examine how much of their respective orbits they have covered compared to Mercury's complete orbit. In actuality a planet's distance from the sun is not the only factor that determines its orbital period, as inner planets move faster than outer planets. However, for demonstration purposes, having the students all walk at about the same speed works well.

CONCLUSION

We have found that this model works extremely well. While it is very similar to many other models, the feature that we believe to be unique and extremely valuable is the way we let the students begin by making the models the way they think they should be; when we then correct their misconceptions, we hit home. In this way, we not only give them a reasonably true scale model of the solar system, but we also make them very aware of their inaccurate preconceptions. It makes the true scale a lot more impressive in their eyes. Also, because you are correcting every student's model and because nearly everyone is always wrong, there tends to be very little ridicule between students. Everyone stands on equal footing and can be equally impressed by the grandeur of our solar system. I encourage you to try it.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Scaled distance from the sun:</th>
<th>Scaled Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>13 centimeters (=58 million kilometers)</td>
<td>1.5 mm</td>
</tr>
<tr>
<td></td>
<td>5 inches (=36 million miles)</td>
<td>1/16 inch</td>
</tr>
<tr>
<td>Venus</td>
<td>23 centimeters (=108 million kilometers)</td>
<td>6 mm</td>
</tr>
<tr>
<td></td>
<td>9 inches (=67 million kilometers)</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>Earth</td>
<td>31 centimeters (=150 million kilometers)</td>
<td>6 mm</td>
</tr>
<tr>
<td></td>
<td>12 inches (=93 million miles)</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>Mars</td>
<td>46 centimeters (=227 million kilometers)</td>
<td>3 mm</td>
</tr>
<tr>
<td></td>
<td>18 inches (=141 million miles)</td>
<td>1/8 inch</td>
</tr>
<tr>
<td>Jupiter</td>
<td>155 centimeters (=779 million kilometers)</td>
<td>25 mm</td>
</tr>
<tr>
<td></td>
<td>61 inches (=483 million miles)</td>
<td>1 inch</td>
</tr>
<tr>
<td>Saturn</td>
<td>274 centimeters (=1428 million kilometers)</td>
<td>20 mm</td>
</tr>
<tr>
<td></td>
<td>108 inches (=886 million miles)</td>
<td>3/4 inch</td>
</tr>
<tr>
<td>Uranus</td>
<td>572 centimeters (=2974 million kilometers)</td>
<td>14 mm</td>
</tr>
<tr>
<td></td>
<td>225 inches (=1782 million miles)</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>Neptune</td>
<td>889 centimeters (=4506 million kilometers)</td>
<td>13 mm</td>
</tr>
<tr>
<td></td>
<td>350 inches (=2794 million miles)</td>
<td>1/2 inch</td>
</tr>
</tbody>
</table>
As an introduction to the subject of poetry, classes of 11-year-olds came to the planetarium in late fall, 1988. The children came to listen to selected poems and compose their own poetry in an impressionable environment. Each class consisted of about thirty students and a visit lasted about 45 minutes.

The planetarium kindled a creative spirit in almost every child and proved to be an ideal introduction to the curriculum poetry unit.

The experience was very positive for the students, teachers and me. As a result, I recommend similar experiences for language and writing groups of all ages, adapted to specific interests and comprehension level. With careful formatting and advance notification, I think that the idea can be extended to community and public presentations as well.

Eight poems were selected for the first section of the program, a listening activity. With a musical background and planetarium visuals, I read each poem with changing speed and inflection, dictated by the nature of the writing. I allowed a few seconds of musical intermission between poems. The total time for the listening section was about ten minutes. A list of poems, their authors, and visuals appears below.

<table>
<thead>
<tr>
<th>Poem and Author</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. &quot;From Blue,&quot; Claudia Lewis</td>
<td>Slide of the Earth from a Shuttle.</td>
</tr>
<tr>
<td>2. &quot;The Earth (Brothers),&quot; Archibald MacLeish</td>
<td>Slide of the Earth; Apollo 8 view.</td>
</tr>
<tr>
<td>5. &quot;Silver,&quot; Walter de la Mare</td>
<td>Slow diurnal motion causes full moon to creep across the sky; only brighter stars are visible.</td>
</tr>
<tr>
<td>7. &quot;The Stars (Sequins stitched to the black leather jacket of the universe),&quot; E. G. Valens</td>
<td>Continued dark sky with stars.</td>
</tr>
<tr>
<td>8. &quot;On Suddenly Awakening Under Stars,&quot; Charles E. Bomgren</td>
<td>Present darkest possible sky with stars and the Milky Way and slow diurnal motion causing stars to creep across the sky. Offer music alone for a few seconds before reading this poem.</td>
</tr>
</tbody>
</table>
All of these poems except the last can be found in the 1984 or the 1987 Tips Booklets, Numbers 12 and 13, published by the Great Lakes Planetarium Association and available from GLPA at a small cost.1,2 "On Suddenly Awakening Under Stars" is from Teton Park Poems, a small volume given to me by the author, which I treasure.3 Charles Bomgren was a planetarium colleague, who served as Director of the Santa Ana College Planetarium in California and as a summer Teton Park Ranger. About 15 years ago, he died in a tragic car accident. Since the booklet probably is difficult to obtain, I'd like to share this poem I used:

**On Suddenly Awakening Under Stars**

<table>
<thead>
<tr>
<th>Sleep's bubble broke</th>
<th>Intensity,</th>
</tr>
</thead>
<tbody>
<tr>
<td>And I awoke</td>
<td>Immensity,</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To praiseful bars</td>
<td>Burned rich with might—</td>
</tr>
<tr>
<td>Of sudden stars—</td>
<td>Black-robed, fire-bright.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To swift, sweet thrill</td>
<td>With joyous fright—</td>
</tr>
<tr>
<td>So huge, so still,</td>
<td>I drank the night—</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Of cosmic sweep</td>
<td>Its endless grace</td>
</tr>
<tr>
<td>That sapped all sleep.</td>
<td>Of chamed space!</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>The night was old.</td>
<td>My heart grew still,</td>
</tr>
<tr>
<td>Round Earth had rolled</td>
<td>As visions will.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(How silently!) My bed and me,</td>
<td>This vision dimmed,</td>
</tr>
<tr>
<td></td>
<td>Til stars, rock-rimmed,</td>
</tr>
<tr>
<td>My sleeping fire</td>
<td>Shone as before—</td>
</tr>
<tr>
<td>Each pinetree spire</td>
<td>No less, no more.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To richer skies</td>
<td>To blink and bless—</td>
</tr>
<tr>
<td>To richer skies.</td>
<td>No more, no less.</td>
</tr>
</tbody>
</table>

Charles E. Bomgren

As I finished reading Bomgren's poem, trying to let music help accentuate and punctuate, I could sense that the children were moved to awed reflection. I let the music play for about ten more seconds, and no one spoke or in any way disrupted the peace. Then I began speaking quietly, with pauses, much as I had read the poetry. I asked the students to consider their feelings and impressions of the sky, space, stars, and moon.

I changed from a musical background to a mood tape of waves, wind, and sailboat sounds. The crescent moon and stars of a December evening were in view. The classroom teacher and I distributed one-battery flashlights with red plastic covers, lap boards, and blank sheets of white paper. Students retrieved pencils from under their seats, which they had brought with them to the planetarium. Instructions were given: "Turn on your light. Shine it only on your paper. Write a word on your paper—'space' or 'stars.'" This was a practice sequence for the main writing activity to come. After students turned off the flashlights, the classroom teacher and I discussed different reasons for writing poetry: 1) to convey the author's perspective or mood, 2) to describe something in a manner that brings helpful images to mind, and 3) to create a mood in a reader or a listener.

As the wave-wind-boat sounds played, perpetuating a relaxed feeling, students were asked to imagine that they actually were on a sailboat under the stars. They were invited to turn on their flashlights and begin writing when they had ideas for poems.

As the wave-wind-boat sounds played, perpetuating a relaxed feeling, students were asked to imagine that they actually were on a sailboat under the stars. They were invited to turn on their flashlights and begin writing when they had ideas for poems.

One by one red lights appeared; students looked up to the sky and back down to their papers. In low voices, the classroom teacher and I were asked questions ... "Is it O.K. not to spell a word right?" ... "May I write about something that doesn't have anything to do with the sky but the sky makes me think about?" ... "Can I write about more than one thing?" ... "You won't tell anyone who wrote this, will you?" We tried to give the answer the student wanted for each concern.

As part of our goal to maintain an unwavering uncritical spirit, we told the children not to put their names on their papers. I announced that the classroom teacher would read a poem aloud in the planetarium only if the student chose to submit it to the teacher. After about five minutes, a few brought their poems to the teacher. A couple asked for more paper. At the end of twenty minutes, at least half of the students in every class submitted one or more unsigned papers.

With the sea sounds and moon and stars backdrop, the classroom teacher read every submitted poem. It was very quiet as all listened and some continued to write. The teacher read well (with a flashlight), knowing peculiarities of each student's handwriting style. She assumed an attitude of subdued enthusiasm and approval for every item. The children's apprehension was diffused by her positive disposition.

Some of the students' brief poems about the sky are given below. I feel that they are fine work for young non-honors children. The planetarium kindled a creative spirit in almost every child and proved to be an ideal introduction to the curriculum poetry unit. A poet-in-residence visited the school during the two weeks following the planetarium visits. The professional poet agreed that the student work was excellent. She liked the idea of the experience so much that she asked to come to the planetarium by herself and write while music played.

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Student poems

The stars are like swiss cheese and bright orange leaves,
Like yellow bees, motionless trees.
The stars are like silent halls in Room 108, like worms for bait.
Yet, they're silent, still, not really able to move.

Stars. So many shapes. So many ideas.
It's hard to believe that they're all from just one night.

By and by the time has gone by,
With the little eyes above talking with time.

The stars are so far. But the joy of stars is close.

The Earth is a miracle floating along under a sea of stars.
For billions of years it floats, trying to find the moon.

Stars, a xylophone of tones played by God.

The stars move up and down and all around.
But they come out to play only at night.

The scanning moon goes skimming 'cross the sky
Like a huge white eye.
The little sparkling stars look like baby eyes waiting on a pie.
The red glare of the sun arrives,
And all is over 'til the next night.

The stars and moon are together a combination,
So terrible, so beautiful.
Together they are closer than anything else in my eyes.
Forever the moment is captured.

Who Are the Creationists

David Chandler
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James Rusk, in his article, "Answers to Creationism" in the September 1988 issue of The Planetarian, presents some very helpful background information on issues raised by creationists. What I felt was lacking in the James Rusk article, and most other critiques of creationism, is a sense of who the creationists are and why they hold to the positions they do. Granted, there are increasingly vocal creationist "activists" who are trying to mold public education in their own image. Their tactics distort both science and theology. These hard liners and their supposed "scientific creationism" are playing a power game and must be met on their own terms. These people, however, are a small vocal minority, even within the fundamentalist churches.

My own interest in creationism is a personal one. I grew up in a conservative Christian environment where creationism was the norm. I found great value in my religious beliefs and was reluctant to let go of them, but I was also interested in science and struggled to make sense out of the two realms in a harmonious manner. I did not give up my creationist beliefs because someone shot them down. Rather, I "evolved" out of my creationist perspective over a period of years as I found new ways of thinking that did not involve throwing the baby out with the bath water.

I believe most creationists in this category are open, honest people who are interested in hearing new information, ... willing to discuss their beliefs in an atmosphere of mutual respect.

Most people who identify themselves as creationists are what I would call "naive creationists." They are the followers, not the theologians. They are to be found sitting in every science class and planetarium show. They usually have not fully grappled with the issues and become hardened in their positions. They are often silent in their objections. Some are very intelligent people who are actively seeking ways to reconcile science with their faith. They believe sincerely in God, they attribute to him the power to do anything he wants, and they have no reason to question that he could or did create the world in six days. I believe most creationists in this category are open, honest people who are interested in hearing new information, if perhaps mistrustful of the views of unbelievers, but willing to discuss their beliefs in an atmosphere of mutual respect. Most of them can't understand what would motivate people to reject God, or what seems to them to be a straightforward and acceptable account of creation in the Bible. There are real and troubling issues these people must overcome to be able to accept a modern scientific world view in general and evolution in particular.

As science educators it is not our role to attack religious beliefs per se. Rather we should respect and assist in the growth process that must go on in all individuals trying to integrate modern understandings of the world with their religious beliefs. The comments that follow do not constitute a handbook for debating creationist activists. I have chosen to discuss three issues that are central to the struggle sincere Christians must face in integrating their beliefs with modern science. It is hoped that non-creationist readers will gain some appreciation for the issues that face an open minded creationist and that readers still in the process of integrating science with their religious beliefs will be encouraged to continue the process.

If God Is Not the Creator, How Is He God?

The doctrine of creation is absolutely central to Christian theology. If God is not the creator how does he have ultimate power and authority over the world or man? What claim does he have on us? For Christians it is essential to recognize that this is God's universe. All Christians must therefore believe God to be creator in some sense. A simple person with little scientific background may resolve the issue most easily picturing God hovering over the universe saying "Let there be light...." Genesis chapter one is just such a straightforward, uncritical statement of faith.

Whether or not this is God's universe is not a matter science can decide. Any claim either way is a statement of faith, not science. What science does witness to is the prevalence of natural law. Within the operation of natural processes it is possible to explain such things as the formation of stars and planets, the origin of the elements, the accumulation of organic molecules lead-
ing to life, and the propagation and variation of species. We should inspire our students and planetarium patrons to grow in their appreciation of natural processes, whether they are naive creationists or naive atheists. If they can be helped to move beyond simplistic slogans into an awareness of the diversity and complexity, but also the simplicity and order of the natural world we will have given them a motive to reexamine their belief system. Some will, others won't, but they will have gained something along the way.

The more one understands and appreciates the processes of nature the less one needs God to fill in the gaps in our knowledge. This can be threatening to fundamentalists who may feel science is leading them toward atheism. On the other hand, if God is used simply to fill in the chinks in our knowledge we have a rather weak conception of God, sometimes called the "God of the gaps" in theological circles. Such a God is bound to be constantly on the defensive as knowledge expands. If life can arise by natural processes without divine intervention perhaps God is not necessary. On the other hand, perhaps the emergence of life gives witness to how subtle and beautiful nature really is, where the entire universe is brimming with the potential of coming alive to give glory to God. It is all a matter of perspective. Obstructing the scientific process is a weak response with a poor track record historically. Creationists should be challenged to find ways of understanding God that do not put them in opposition with the search for truth. After all, if God is truth, there should ultimately be no conflict.

Meaning out of Randomness

Living organisms are truly phenomenal examples of order and complexity. How could such order emerge out of the chaos of the universe through chance? If the universe did emerge through chance, how do we escape the conclusion that all is meaningless?

These are questions every thinking person must come to terms with. Einstein was no fundamentalist, but even he, in other contexts, had difficulty accepting that God played dice with the universe. Many Christian fundamentalists reject evolution because random processes seem incompatible with the basic premise of a purposeful creator. Those who lobby against evolution frequently play on this theme to ridicule it. They compare evolution with a dictionary resulting from an explosion in a print shop. How can a chaotic world of atoms turn into the ordered structure of living organisms by chance?

The "how" question has an answer. Evolution is based not only upon randomness but also selection. A better analogy is this: what are your chances of finding your name in a can of alphabet soup? The chances are pretty good as long as you are there to recognize the right letters as they swirl by and pick them out. This is what actually happens in nature. Our blood stream carries digested alphabet soup past the cells of our body which select what they need and reject the rest. As long as the soup we eat is nutritious enough, the cells can grow and manufacture new living cells out of molecular building blocks. What we are watching is nothing less than the transformation of nonliving molecules into life before our very eyes. Every time a cell divides a new living thing has been created by natural processes. A cell is literally a life factory. If one can accept that cellular division is a natural process it seems like a small step to believe that these microscopic life factories can gradually retool over eons of time.

The meaning question is harder. Does life have ultimate meaning? How can life be meaningful if it arises out of chance events? Must life be laid out in advance and planned by God to be seen as meaningful? These are deep questions that each person must answer in his own way. What I offer here is merely an observation that the question of meaning in a world of random events need not be an insurmountable obstacle to Christians. There is a parallel in Orthodox Christian theology. For Christians there is meaning in Christ's death. By any ordinary standards dying at the hands of one's enemies would be a defeat, but in Christian theology this defeat is nothing less than God's ultimate victory over the forces of evil. My question is simply this: if Christian theology can see victory in what was overtly a defeat, can it not find transcendent meaning in what is overtly the work of chance?

... for individuals with strongly held religious beliefs the process of coming to terms with evolution has a human dimension that is more complex than many people realize.

Biblical Creation Accounts

Fundamentalists in particular, but Christians in general, hold the Bible to be the source of their faith. Some creationists feel they are obliged to hold the positions they do because, to quote a slogan, "the Bible says it, I believe it, and that settles it." That seems like a pretty impenetrable wall at first, but perhaps it is not.
Beliefs about the nature of the Bible in conservative churches vary. It may be described simply as the Word of God, leaving the details of how God speaks to man through the Bible open to interpretation. Fundamentalist churches tend to put more qualifiers on the doctrine, such as inspiration, infallibility, inerrancy, etc., up through literal verbatim dictation from God. My experience is that the more restrictive the doctrine of inspiration, the less the people are able to read the Bible for themselves with comprehension, and the more they rely on authority figures to quote it and interpret it for them. In churches and in devotional literature the Bible is usually read in very short passages, with the focus on individual words or phrases.

The key in any discussion of the Bible is to be familiar with it directly through first hand reading as an adult, not from memory of childhood stories and sermons. I recommend actually sitting down and reading through the book of Genesis. It is not that bad. Anyone who tries this, however, will recognize certain difficulties from the outset. There is a general progression through the book, but there is not a unified story line. Genesis does not read like a novel, or a history book, or a list of commandments, or any other simple text. It is amazingly choppy and repetitive. It resembles a patchwork quilt more than a single weave. Most biblical scholars today believe the original material in the book of Genesis was handed down through oral tradition in the form of sayings, songs, stories, etc. for hundreds of years, collected at various religious sanctuaries in the early days of Israel, compiled in various early written forms for various historical reasons, then edited into the form we have it today late in the history of Israel.

But if the work is a collection of writings by different authors with different styles, different viewpoints, different cultural influences, and different historical settings, what becomes of the concept that the Bible is the word of God? Can a fundamentalist dare venture down this road without the certain prospect of losing his faith? No one can tell from the outset where an open mind may lead, but there are many Christians who recognize the cultural, historical, and even the theological diversity of the Bible and still discern the voice of God through it all. Can God speak to man through other men? The long tradition of preachers in the church would seem to support this. If God can speak through ordinary men, with all their limitations, is it too much to believe that God can speak through the medium of human literature, with all its limitations as well?

It is a cliche that everyone has his own interpretation of the Bible, but there is actually a near consensus among academic theologians that crosses Catholic, Protestant, and Jewish doctrinal lines on many of the central issues. Fundamentalists lie outside this consensus. The consensus view is that Genesis is an interweaving of at least three earlier written sources (labeled J, E, and P by biblical scholars), each of which draws on a wealth of earlier material handed down through oral tradition.

The seven day creation narrative is from the P source, attributed to priestly writers in about the sixth century B.C. The garden of Eden story, on the other hand, is attributed to the J source, who was writing about the time of David or Solomon. A key difference that helps separate the two strands is the term used for God. In the P tradition it is asserted that the name Yahweh, the proper name for the God of Israel, (translated LORD with all upper case letters in most English translations), was not known or used until the time of Moses (cf. Exodus 6:3). Therefore throughout Genesis the P writer refers to God by the generic term El or Elohim, which is translated simply as God. The J tradition, on the other hand, attributes knowledge of the proper name Yahweh to the children of Adam and Eve (Genesis 4:26). In passages taken from the J source, the name Yahweh is used from the outset. Many other stylistic differences can be correlated with the nomenclature for God.

With this in mind, read the first three chapters of Genesis. The P narrative extends from Gen. 1:1 through 2:4a. God is simply called "God" (Elohim). Creation is by the spoken word: "Let there be... and there was ...." God is pictured as a transcendent spirit moving over a primordial "sea". The P creation account is a highly structured, liturgical recitation of the creation week which is presented as the source of the Sabbath cycle in Hebrew tradition. There are eight creation events (each starting "And God said ...", blocked into six "days." The "days" are each bounded by evening and morning, so it is clear the writer was not thinking about eons of time. On the other hand, the first "day" occurs before the creation of the sun and moon, so they are not natural days either! It makes better sense to consider the days of creation to be a literary device for purposes of liturgical recitation, rather than literal statements about units of time, whether hours or eons in duration.

The J narrative is the familiar Garden of Eden story, which begins in Gen. 2:4b and continues through chapter 3. God is called "The LORD God", which is translated from the proper name Yahweh Elohim. God is pictured in vivid anthropomorphic imagery of a potter molding the clay of the ground into human flesh, breathing into it the breath of life, planting a garden, and walking in the garden in the cool of the day. The contrast with the lofty spiritual imagery in the P narrative is striking. Unlike the opening of Chapter 1, the
initial state of the earth is a dry, barren landscape.

The sequence of creation events in the P account is (1) light, which is separated into day and night, (2) the "firmament in the midst of the waters" (literally the solid dome of the sky, cf. Job 37:18), (3) the gathering of the waters to create seas and dry land, (4) vegetation and trees, (5) the sun, moon, and stars for signs and seasons, (6) sea creatures and birds, (7) land animals, and finally (8) "man", male and female.

By contrast, the J narrative is loosely structured into a flowing narrative and no particular time frame. The sequence of creation events begins with man, interpreted as a male. To meet the man's need for food, plants and trees are created. Then in an attempt to find companionship for man the animals and birds are created. Finally woman is created as the perfect fulfillment of man's need for companionship.

Surely we must conclude that the literal details were not the real focus of the editor.

Do contradictions between multiple strands like this somehow discredit the Bible? Only for a rigid Biblical literalist. Whoever set these two narratives side by side, preserving their distinctive literary qualities in the process, could clearly see these are two accounts of creation that do not fit together in their details. Surely we must conclude that the literal details were not the real focus of the editor. The sequence of creation events seems like inconsequential trivia when compared with the meatier theological issues dealt with in these chapters: the claim that God is supreme over his creation, that the material world is good, that man is created in the image of God, that God has provided for all the needs of man, that we are caretakers of creation, and that human sexuality is to be viewed as a gift from God.

Conclusion

Evolution is central to the modern scientific world view. It goes beyond the realm of biology and impacts thinking in all of the sciences. Science educators should be free to speak as confidently about evolution as they would about Newton's laws of motion in physics. "Creation science" is neither good science nor good theology. Its influence in our public educational system should be resisted vigorously.

On the other hand, for individuals with strongly held religious beliefs the process of coming to terms with evolution has a human dimension that is more complex than many people realize. I would not recommend watering down presentations of scientific concepts for their benefit, but neither would I recommend scorn as an appropriate response. I do not have a prescription for dealing with creationists in concrete terms, other than to suggest that both parties need to learn patience and have a willingness to listen as well as speak.

Latest News on IPS '90

The tenth biennial International Planetarium Society Conference takes place in Borlange, Sweden, July 15-19, 1990. Its theme will be "The Boundless Planetarium," and the program filled with lectures, workshops, paper sessions, tours ... -a real Swedish Smorgasbord style conference! The Organizing and Program committees are working with the preparations and bulletins which will follow in coming issues of The Planetarian.

Announcement and Call for Papers will be sent to everyone in the IPS Directory in June, but here are some important dates to put in your almanac today. Note especially that the deadline for Abstracts is November 1 this year!

November 1, 1989
Last day for one-page abstracts of contributed papers. Type it clearly and within 18 x 25 cm (7 x 10”), since it will be used as the printing original in the Book of Abstracts, and send it to me.

January 1990
Invitation and Program sent out.

April 1, 1990
Last day to register for post-conference tour to Stockholm, Helsinki and July 22 total solar eclipse.

May 15, 1990
Last day to register for IPS '90 Conference

Welcome to The Boundless Planetarium in Sweden next summer!

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Selecting Equipment for an Integrated Video System for the Planetarium

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During the 1987-88 academic year, the Waubonsie Valley High School Planetarium became a leader in the area of laser disc technology for the Indian Prairie School District. In the planetarium, the laser disc's technology and viability was to be tested as a possible direction for the district to pursue for use in other areas. The planetarium's role was justified because of the number of children who would experience the results of the technology in learning experiences and because of my interest in the technology.

During the year, my job was to analyze the equipment, software, and laser discs available for use in the planetarium. This report is a result to help those who may be considering such a choice in the near future. I will make mention of manufacturers and their model numbers only as a means of reference and comparison, and not as an endorsement of the equipment.

In analyzing the problem of equipment choice, we soon realized that the planetarium's equipment would in some state of continuous use during 4-10 hours each school day. We estimated that the equipment should have at least a 10-year life expectancy. Big projects of this type do not come around often, and I did not want to return to my supervisor in the future to report that the equipment was now worn out and replacement was necessary. This led us to eliminate consumer market equipment and head straight for the industrial video dealers. We talked with many video suppliers, had equipment demonstrated under our dome, and talked with planetarians. Our complete system included a video projector, a laser disc projector, a video tape player, a monitor, and a microcomputer.

The Video Projector

All parts of the integrated system are important, but it is the video projector that places the images on the dome. It must be able to compensate for all the problems associated with curved screen projection. In our case, a wired remote control was necessary for signal input and dimming control.

Since we do not have our planetarium instrument on an elevator, the projector had to be placed on the instrument skirt, and tilted upward at a 20° degree angle.

... my job was to analyze the equipment, software, and laser discs available for use in the planetarium.

During parts of our lessons, the planetarium's house lights are increased so students can write to questions we provide. It was important that the projector's luminosity be high enough to be seen with the lights on.

Besides showing video images, the desire for computer graphics became a major factor. More about this in the selection of the computer.

Specifically, the wired remote should accept at least two video inputs, and provide controls to monitor each video signal before sending it to the video projector. The remote should vary the brightness along an entire intensity that equals the brightness control of a slide projector. The wired remote should control the RGB computer graphics input, although the RGB signal is sent through a separate cable.

The projector that provided these qualities is the Sony VPH-1040Q.

The Laser Disc Player

If you talk to five different people about laser disc players, you'll probably hear five different opinions. The choice was narrowed greatly because of the industrial grade requirement.

Several planetarians praised the Pioneer 4200 player. Our concern with this player was the description "lightweight industrial player." Does this mean...
upgraded consumer or downgraded industrial? We never received a sufficient answer, so we eliminated it from our selection list.

Another factor against the 4200 is that it is a "slow" machine. The laser may take up to about four seconds to find an image once the microcomputer sends its commands.

We looked for the fastest selection time available in an industrial machine that accepts commands through a serial computer interface. Our first choice was the Sony LDP2000/2. Because the supplier could not deliver this player before the beginning of the school year, we chose the Pioneer 6010A. Both machines are practically equal.

These two machines can find images in less than two seconds. In most searches, the 6010A is as fast or faster than advancing a slide projector.

One disadvantage of the 6010A is that the player is not put into a play mode when a disc is inserted and the drawer closed. The player can be initialized with the remote control unit or with a command from the computer program. This is only a small problem when you realize the benefits of this player's speed and projected dependability.

The Videotape Player

Our goal with the tape player was to be able to access portions of a tape from the player's remote control unit. This would allow us to prerecord and index movies from laser discs so we would not have to attempt to change discs in the darkness. This medium would also allow us to use video that is not yet on laser disc.

The tape player must be able to mark (index) and access indexed sequences along the tape.

When you search for a player with this feature, you'll probably get other desirable features like hi-fi digital and SVHS along with the indexing feature.

We selected the Panasonic AG-1830.

The Computer

In the selection of a computer three major components emerged: programming, RGB graphics, and price. With the funds already budgeted for the three previous items, we needed to find a reasonably priced computer on which we could program and create RGB graphics. Even with a tight budget, it was necessary to investigate all possibilities. Our first choice was a Macintosh II. With a color graphics card, we could create high resolution 3 megabyte images, an exciting possibility! The price was simply beyond the budget, plus the scan rate of the Mac II and the Sony video projector are incompatible.

We considered other Macintosh versions with aftermarket color video cards, but the price was beyond our limit.

The Apple IIgs became our choice. We can control the laser disc player and access fairly good resolution RGB graphics. I have previous experience writing BASIC programs for previous versions of the Apple II and I taught BASIC programming in our computer lab for two years. I was confident that we could interface the computer and player.

This important addition will allow us to use the optical projection of our Minolta planetarium to present a realistic sky while computer graphics programs simulate proper motion and stellar parallax, although in a simpler way than the computer graphics planetariums. We visualize this as simply the best of both worlds: optical projection of the stars and computer simulation.

The Computer Program

A computer program was created to create, edit, and control the image selection for the planetarium lessons. Using the potential of the player, the control function of the program can run movies forward/reverse and access the various special effects of the player.

One major obstacle was to understand the language of the strange laser disc player codes and integrate them into the computer program. To date we have about 100 man-hours in writing this custom program.

One feature of the program is that through use of the four arrow keys, the preprogrammed order of events for the lesson can be changed. It serves as a means to answer student questions and review.

The Monitor

The monitor serves as an important subfeature of the system. We use it to check images before they are sent to the video projector and to find images when lessons are created. Actually any high quality monitor or television will suffice.

(Please see Selecting on page 51)
Digital Television Techniques and Interactive Video Applications in the Planetarium


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Recent advances in television projection technology, digital production techniques and audience participation through interactive video promise an exciting future for planetaria. Much of the pioneering work in this field has been carried out at the Armagh Planetarium, Northern Ireland, and this paper describes the Armagh installation, its present use and future possibilities.

For some years now we at the Armagh Planetarium have followed a policy for the development of video as the main source of special effects and image presentation in our Planetarium. The development stage is now complete and the implementation is transforming not only the manner of our Star Show presentations but their quality in terms of both entertainment and educational value.

Planetarium audiences today are increasingly used to a visual presentation of astronomy and space on broadcast television of a quality and pace which planetaria find difficult to emulate.

Planetarium audiences today are increasingly used to a visual presentation of astronomy and space on broadcast television of a quality and pace which planetaria find difficult to emulate. Audiences, therefore, often find many planetarium shows, which are basically sophisticated tape/slide presentations, slow and lacking in visuals. For most small and medium-size planetaria there isn't the time or money available for the construction or purchase of the elaborate special effects and imagery which are available to the larger planetaria.

The problem lies in the nature of planetarium special effects which are largely electro-mechanical devices. Because of their construction they can usually present only one effect at a time. A rotating galaxy cannot easily become a zoom into a planet, a condensing star or exploding supernova. Duplicating such an effect requires the construction of an identical projector and control equipment and the cost is practically the same as the original. A video projector is different and, as it is purely dependent on the image presented, it can become a rotating galaxy, a zooming planet, an exploding star without any problem at all. In addition, once an effect has been produced on high-quality video, a good copy can be made at a fraction of the original cost. This in itself will allow the smaller or poorly-funded planetarium access to sophisticated effects and images which otherwise would have been too expensive and complex to make. Of course, reducing the number of projectors does away with the need for a lot of automation controls and, hence leads to another saving. In addition, the projector can be used in other ways; for example, to present graphics of show images from spacecraft encounters or launches, or even images from telescopes. All these different uses can add a new dimension to...

... once an effect has been produced on high-quality video, a good copy can be made at a fraction of the original cost. This in itself will allow the smaller or poorly-funded planetarium access to sophisticated effects and images which otherwise would have been too expensive and complex to make.
planetarium presentations and provide audiences with a great sense of participation in events.

For the small planetarium a single video projector can replace a great deal of equipment and controls. The costs of the projector can soon be made up through the savings in special effects. And, the added zest in performances will attract larger audiences.

Image presentation with video can be given more "pizazz". Take, for example, the presentation of a single 35 mm slide. With existing electro-mechanical equipment the picture can be projected on one plane. If the projected image is to be moved, a moving mirror assembly is required; a zoom requires motorised lens, and a rotation of the image can be achieved with a motorised slide plane. Of course, all these need to be controlled. A machine to do all this to one image is not only complex but very expensive; in fact, almost the same price as a low cost video projector. However, if the image or picture is put on video and digitised, it can then be manipulated using standard television production techniques. The image can now be activated in many different ways. The image can be flown through space with an infinite variety of speeds. It can be made to zoom or rotate. It is even possible to pivot the whole image on any axis and rotate as if in three dimensions, like a rotating card, to reveal another image behind. Just try that with a conventional projector! All this means that image presentation can be liberated from the structures of the slide projector and made more dynamic and interesting for the audience. In addition, interesting and spectacular effects can be created at reasonable cost, copied and distributed easily.

At this point I should stress that, in terms of the projected picture, I am not just speaking of what the audience perceives as a rectangular image. I also mean that all these effects can be done to an unformatted image, a planetary disc, a spacecraft, or an irregular nebula. All of these video images can be projected against the starry background, inserted if you like into the planetarium sky without any sign of the full rectangular format, thus producing a form of electronic matting. This is achieved by having the image surrounded by perfect electronic black and ensuring that the projectors have sufficient control over brightness and contrast levels to allow the projected black to be invisible. It is the use of this type of projected image which is transforming the production values and pace of planetaria using video. In addition, there is the development of interactive video using laservision discs. These can store both moving and still images, which through microcomputer control, can be called up at random with very fast access times. But more of this later. First, let us look at the equipment needed to make use of video on the planetarium dome.

In the small planetarium the basic requirement is a single projector, a video tape player and a video disc player. The projector should be set up to throw the image directly onto the projection surface of the planetarium dome and not, as I saw recently in Japan, onto a screen positioned behind the dome itself. Each time the high-definition TV picture was to be projected, a section of the dome opened to reveal the screen behind. This absolutely ruined any illusion built up in the theater and totally destroyed the pace of the presentation. It is not necessary for most planetaria to be able to produce their own effects as increasingly these will become available from other planetaria specialising in production or from special-effects manufacturers. With larger domes comes the need for more sophisticated productions and additional equipment. This need not be purchased all at once but can be phased over a number of years. This has certainly been our policy in Armagh with equipment accumulated over a period of six years. We now have a well-equipped theatre which meets most of our needs and provides a useful model for other installations.

The Armagh Planetarium has a fifteen-metre dome with a Minolta Series Two projector. We have 120 aircraft seats mounted concentrically. We now have five video projectors; three made by Sony and two by Bell and Howell. Those from Sony are the oldest and have been in use for six years. They have proven to be extremely reliable though, of course, they have nowhere near the resolution of their present counterparts. Four of the projectors are floor-mounted around the base of the main projector. The projected image is thrown about half way up the dome at each of the cardinal points. Each image size is about 7 m by 5 m. The fifth projector is floor-mounted at the control console which is due east. This projector is on a car jack so that it can project anywhere from zenith to horizon. It is, however, not moveable during projection. All our projectors are multi standard capable of accepting PAL, SECAM and NTSC video sources and all automatically

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present mixed sources without manual selection. We have used all three sources regularly and every day material in both British Standard PAL and American Standard NTSC is used. SECAM is normally used when presenting material from the Soviet Gorizont satellite. In this manner we have covered Soyuz launches and made plans to present the encounters with Mars and Phobos in 1989. Multi-standard capability adds a small additional cost to the purchase of the machine but it more than makes up for that with its increased flexibility.

We produce the original video for our star shows on rented equipment in a professional studio and effects complex called AIR TV in London. It is only in such facilities that the necessary equipment is readily available and economically feasible. Often such facilities welcome the unusual requirements of a planetarium as a useful showcase and therefore provide equipment and services at very low prices. All our original material is mastered on 1" (25 mm) broadcast quality tape. It is then transferred to 3/4" (18 mm) U-Matic tape. Presently such tapes are used in two Sony 5600 players for Star Show presentation. Soon these will be replaced to two new Sony machines in their SP range which provide for very high resolution replay, higher than "High Band" which is often used for broadcast. In the United States 3/4" high band has not been available but they have used what we term low band. Fortunately, SP U-Matic is available in the States and can be highly recommended as an economical source of high quality video for planetarium projection. A new form of 1/2" (12.5 mm) VHS tape known as Super VHS is now becoming available. For the small planetarium requiring playback only and without heavy use this system should be considered. However, for the planetarium with editing requirements of heavy use, the robustness and reliability of the U-Matic format is essential. In addition to tape machines we also have a number of Pioneer laservision video disc players in both PAL and NTSC. Unfortunately, no multi-standard discs players are made. We utilise material on discs produced by Video Vision Associations in the United States and that which we have produced ourselves in conjunction with Sky Skan Inc. of Nashua, New Hampshire.

Until recently most of our Star Shows would have had all the video effects on the two tape decks which run together. Each machine can be made to feed one or any number of the five projectors. The video images are kept in synchronisation with each other and with the main audio track by a time code reader and actuator called a "Q-Lock". The master audio is on five tracks of an eight-track machine. Two of the remaining tracks have the automation information for our panorama projectors etc. The last track is used to record the "Q-Lock" time code which is also recorded on one of the two audio tracks available on each U-Matic tape. The Q-Lock reads these time codes and keeps the whole show in sync. In this manner it is possible to locate any part of the show automatically or pause the show and re-start while still remaining in sync. Of course, for a single player/projector set-up such elaborate synchronising systems are not really necessary. Newer tape players, such as the Sony SP, come complete with an RS232 interface and lend themselves fairly easily to microcomputer control and synchronisation. In a normal passive Star Show performance 90% of our effects will be presented from the two U-Matic players. Public reaction to the images and better presentation afforded by video has been very favourable. Certainly, very few realise that they are seeing a projected video image. However, tape playback of effects was only phase one of our project. The most dramatic and interesting phase is just beginning: it is the realization of a totally interactive Star Show where the audience can fully participate in the performance in real time.

This is achieved through the use of a specially made video disc containing the star-show material comprising effects, stills and sound track. Used in conjunction with a microcomputer, video disc controller, and individual response units for each member of the audience, this allows a fully interactive, audience controlled, presentation to be made. Of course, it is not necessary to have this level of interaction in every type of star show, but the basic equipment can allow the audience to participate in many different ways during all types of presentations.

The basic interactive equipment we have built enables each of the 120 seats to have a three-button response unit. Each unit consists of three colour switches and LED's (Light Emitting Diodes) coloured red, green and yellow. The total light level for all units is controllable from the console and the response units can be activated for audience input by software control from the microcomputer. The micro also performs a diagnostic routine prior to each show and automatically alerts the operator to malfunctioning units.

By means of a simple program it is possible to present information to the audience and seek their response.

All response units are linked to a simple Pioneer PX7 computer which has a modest graphic capability in addition to a built in "genlock". Genlock is the ability to superimpose or insert data or graphics onto another
video image from an external source. Interfaces were built which instantly tally the audience response from the buttons and present the data in graphical form via the PX7. This information is projected onto the dome/sky via the video projectors. By means of a simple program it is possible to present information to the audience and seek their response. Questions or choices are colour coded, and when the audience responds a histogram showing the percentage vote in coloured graphics and figures is projected on the dome. Although it only takes a fraction of a second to read the audience response, we have found that a three or four-second thinking time was favoured by the audience. This allows time for a change of mind, and as the graphics rise and fall a certain amount of fun is generated during the response phase drawing interesting and unusual comments from what would normally be a rather reserved group. Of course, children really enjoy this bit. The program which we run has the ability to record the audience responses and print them out at the end of the presentation. We hope that over a period an analysis of this information will give us a better indication of our audiences' appreciation and comprehension level, leading hopefully to more interesting and enjoyable presentations. So far, audience response to the system has been overwhelmingly enthusiastic with very little abuse of the response units and tremendous automatic discipline of excited school groups.

The audience therefore actually controls its own show.

Technically it was a relatively small step from allowing the audience to make choices and give responses to enabling those responses to automatically activate the star theater equipment. The audience therefore actually controls its own show. The first show of this type to be presented in any planetarium is called Odyssey and will run in Armagh Planetarium from December 1987. Odyssey is a guide to the Solar System where the audience uses the interactive system to explore the Sun, planets and minor bodies at will. It was designed so that the audience must learn a minimum amount about the Solar System but it was also felt that they should choose the level of exploration for themselves. Given the right kind of choices, it is possible for an audience using this system to tailor a show to its own level of comprehension. The production of the show had to take these and many other factors into account. There were two major constraints on the storage capacity of the interactive disc and the total duration of the show. If the show lasted too long, people could become bored or simply tired of making decisions, and if too short they could feel disappointed. An average running time of 40 minutes was chosen, of which about five minutes would be given over to scene setting, learning the use of the response system and a quiz. The remaining 35 minutes would come from the disc. An interactive NTSC disc is limited to 30 minutes continuous material or 54,000 individual pictures.

We decided on a mixture of moving effects and still frames. With 28 minutes of video, that left room for up to 1,200 still pictures. In fact we only used about 300. The disc has two sound tracks A and B. Track A was used to provide the mixed narration and sound track for the video effects. Track B provided the narration and effects for the stills. This meant that one disc could actually provide sixty minutes of material of which about 35 would be accessed during an average show. By using two copies of the same disc, a number of disc players and a controller, it is then possible to call up a still from one disc and play the appropriate sound track from the other. Thus we make full use of the random-access facility offered by disc. The software in the operating program would ensure correct matching of sound and pictures, we hoped! It worked and so the first totally interactive Star Show was born.

The actual images of the bodies to be visited were all produced on video and we used digital trick effects to give the impression of our approach or recession. It was also possible to have tumbling moons and sweeping comets. The majority of the images are real and based upon the latest material. The only exceptions are Neptune, Pluto and Charon which so far have eluded the cameras. Artistic license coupled with our present knowledge allowed us to present reasonably realistic impressions of approaches to these bodies. Data for all the major Solar System bodies was prepared and presented in the form of an animated graphic which gives information on size, distance, orbit, rotation etc. The whole concept was based on the journey of a tourist-class spaceship of the twenty first century. The Planetarium theater is the observation dome of the spacecraft and, using the ship's computer, we can get HED (Head Up Displays) of planetary information projected in the dome. It is also possible to despatch probes to explore planets or probe their surfaces with radar. The amount of fuel carried by the ship controls the amount of time available for exploration, but apart from that the show is totally in the hands of the audience.

In practice the show goes something like this. When the audience enters the theater we are already in low-earth orbit. It is the year 2020 and we are in the Gagarin space port. Visible on the dome is a rotating earth chord, and a number of other space vehicles are in the sky. This is really the only fictional aspect of the show. There is no walk-in music—just the drone of the spacecraft machinery and other background noises. One fellow planetarian told me this was the best effect in
the show! The audience is introduced to the response system and to how their choices and answers are presented on the viewing dome of their spacecruiser. There is a ten-question quiz about the Solar System. The answers to this are designed to help us gain an understanding of the level of awareness of solar system data. Next, they must learn about their home planet, Earth. This is done through the use of still frames, radar scans and weather-satellite data which are selectable by the audience. During this show we use three video projectors. One projector shows the approach to a body and a single image of, say, a planet while still the other two projectors present data or stills. This is to ensure that the whole audience gets good views of the most important data and pictures. Obviously, when approaching or leaving a body only one projector is used.

Once the earth sequence is over the program automatically begins to offer a series of destinations. The first is the moon, Venus or Mercury. Each choice is colour-coded red, green and yellow, the same colours as their illuminated buttons. The colour questions are projected and as the audience makes a selection they see their responses as moving coloured histograms. Let us imagine they voted Venus: 60%, Moon: 10%, Mercury: 40%.

The Earth will now disappear as with appropriate effects we head off to Venus. This will be happening in the western sector of the dome. Soon the Earth has become a tiny dot and the ship's computer presents its data screens on Venus. These are simultaneously projected in the north and south sectors.

Then we begin to approach the planet in a long curving zoom. Soon we have achieved orbit and a large image of the planet remains in the western sector. Meanwhile on north and south the computer is asking what next. We can have a radar scan, despatch a probe or see an atmospheric movie. The audience chooses a radar scan. Almost instantly we see a giant rotating planet devoid of cloud. This is the spectacular radar model of Venus based on the Pioneer observations. Like most visual effects it lasts for a maximum of forty seconds, though many are much shorter. Another series of choices appears, and so on. This time the audience decides to send a probe. We see the probe on its way and then we get the television pictures from the surface. These pictures are those from the latest Soviet Venera craft. Another series of choices follows, including one to leave Venus. Let us leave. Now the computer shows the amount of fuel we have left and presents the next series of destinations. Venus shoots away from sight and we fly off to continue our voyage of exploration. At the beginning, we explain to the audience that we are using a trajectory which allows us to fall in toward the Sun and accumulate speed to get out into the outer Solar System. In reality, the whole exercise is much more interesting to watch than to describe. Some audiences spend as much time as they can on five or six objects and so don't reach certain planets. Others skim over each object and hope to have enough fuel for a longer stop at one or two on the way back. The options are enormous and so is the fun. Of course, we have built in a few surprises here and there and, yes, we do record the audience responses. These can be printed out and are giving some interesting insights into Solar System favourites. Presently, these are the Sun, Saturn and Uranus. Surprising isn't it?

To run the show we operate our full response and graphics system on the Pioneer PX7 Micro. This is used to trigger a much more detailed branching program held on a Pioneer UCV102 video disc controller. After the initial manual preamble, the operation of the effects and information is totally automatic. We do not cheat in any way; the audience does all the hard work.

The response system was designed and built in-house by our planetarium technician Stephen Armstrong. It has been is use for almost 12 months now and is standing up reasonably well to wear and tear and has been very reliable. The video material for the show was designed and produced by me using the facilities of Air TV in London. The disc was pressed in NTSC so that we could make the material available to other planetaria where NTSC disc players are the most numerous. The disc was pressed by Pioneer in the United States and the quality of the pressing is superb. The script for the show was written by British astronomy and science writer Ian Ridpath and narrated by Roy Larmour. The music and effects were specially composed by Ernie Wood of Cinetraw and post production audio was by Videosonics of London.

Of course, there is a great deal more to say about video. There are the new electronic graphic systems, and there is a revolution in computer graphics with the arrival of the transputer. New high-resolution tape players are coming on the scene accompanied by high-resolution projectors which are brighter, more versatile and cheaper. It is even possible to double up projectors to achieve the greater throws necessary for the larger domes. The proper utilisation of video technology promises to give a new lease of life to planetaria both small and large. It offers the greatest possibilities for the sharing of material and gives us all the opportunity to perform our task of both entertaining and educating our audience so much better. In technological terms we may still be rather primitive, but mark my words "You ain't seen nothing yet." 

The Planetarian, Vol. 18, No. 2, June 1989
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Beyond the video are two tracks of Audio: Track one contains frame-synced music and sound effects by Mark Petersen and Ernie Wood. Track two contains four longer compositions by Jonn Serrie. Also included are three slides (Phobos chord, Saturn Moon chord, and Earth Moon chord) coordinated to specific effects, production/education notes, and copyright clearance for your theater.

**THE SKY-SKAN SPECIAL EFFECTS LASER DISC NO. 1 IS AVAILABLE NOW! ORDER PART SS-700**
At the IPS Conference in Richmond, Jeanne Bishop presented a paper entitled "We’re Regarded as Experts ... Let’s be Responsibly Accurate." That paper was published in the March 1989 issue of The Planetarian.

Many colleagues responded to Jeanne’s paper at the time of presentation. They, and several others who attended the talk, were asked to consider the ideas she had posed and to answer the following question:

Most planetarians know from experience that a planetarium is one of the first places contacted when someone either wants to share or acquire astronomical information ... If we do not present information accurately ... we contribute to scientific illiteracy, and those who know something has been wrongly depicted may lose confidence in the planetarium as a source of correct information." What are some of the pitfalls that you’ve dealt with and what precautions do you take to ensure accuracy?

If you have any further comments to make on this topic, please submit them to Lonny Baker. Comments received by July 10 will be included in the September issue of The Planetarian.

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The question of astronomical accuracy in the planetarium is one with which every planetarium program producer has wrestled (or am I just frightfully naive?). I am in ironclad agreement with Jeanne Bishop that we should not contribute to scientific illiteracy as a result of information dispensed in our shows, or by other means in our professional contacts with the public. There, I said it.

Now to drop the other shoe. To a certain extent, we are all guilty of being slightly inaccurate concerning astronomical matters, and probably always will be. Now before you say that I’m speaking out of both sides of my mouth, here’s the grim reality: I am. Perhaps I’m really speaking from underneath two different hats, which all of us wear from time to time (and which more of us should attempt to wear simultaneously). First, there’s the mortar board of the scholar: checking facts, making sure that the Moon really does appear in a certain constellation, trying to keep our presentations within the realm of plausibility; that sort of thing. The second hat is the beret of the artist: broad vistas of worlds yet undiscovered, times and places beyond human experience.

We are confronted with the challenge of exciting our audiences while informing them about the wonders of the universe to the extent that we are capable of understanding those wonders, and within the constraints of our presentation technology. That’s a large order to fill. One might get the impression that coping with accuracy is, to borrow from a popular American beer commercial, a "tastes great/less filling" proposition. It doesn’t have to be. There will be some tradeoffs made, granted. But when we’re putting together a show we should at least be conscious of those tradeoffs, and not just do things a certain way out of habit.

Let’s take as an example one about which everyone who has watched a planetarium show has an opinion—audible explosions in space. I would be disappointed if a planetarium’s rendition of the Big Bang didn’t rattle my toenails, acoustic medium or no. "Aah, but there can be no sound in space." So what?! I don’t hear music in the background when I go through everyday life, either. Yet we use music all the time. To me, the use of an audible explosion is akin to the use of music. It sets an emotional tone.

There is one item which has irked me in past productions I have seen, which can be remedied very easily—the apparent lighting of objects in a planetarium scene. For example, imagine a scene composed of multiple images: a star, a planet, a moon or two, and a spacecraft zooming through the midst of all this. Nice, eh? Take a closer look. More than once I have seen the various components of a scene like this apparently lit from every-which angle without regard for the location of
the source of illumination. In the majority of cases this can be fixed by simply shuffling the images around. If you use spacecraft models in your show it might pay off to light them from many angles at the same time you are shooting them. This will give the producer more flexibility in crafting a scene that is not only aesthetically pleasing, but slightly more accurate as well. (For those who can't afford to shoot rolls and rolls of film, careful planning by the producer can still yield favorable results.)

It might do us all good to remember that while we owe our audiences a quality performance with up-to-date information, our artistic and poetic licenses are still valid. Use them carefully.

Thomas W. Hocking, Education Assistant
Morehead Planetarium
Chapel Hill, North Carolina 27599

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I'm not sure what it is in me that becomes extremely disturbed at seeing the following depicted in cartoons, on television, in movies, written in newspapers or books, or projected onto a planetarium dome: photos of the Moon which couldn't have been taken from Earth, but are intended as such; lunar phases which are impossible given the hemisphere and the time; 'telescopic' views which could never have been obtained with a telescope; attitudes of constellations which would look that way only from Antarctica; statements regarding "the constellation of the Big Dipper;" and hundreds of similar astronomical inaccuracies, misconceptions and errors.

After all, what's the problem? The average person probably sees nothing amiss here, and no doubt they recognize the symbolism intended. Surely these are harmless errors by the cartoonists, producers, authors, and editors involved. (Besides, that composite image of the back side of the moon rising over Kitt Peak looks great!)

Who cares that a waning lunar crescent on the western horizon at sunset might be wrong?

Shouldn't we be happy they're acquainted with the word "constellation" without confusing them with another word like "asterism"?

What difference does it make that these things don't reflect reality and aren't right?

I think it makes a lot of difference!

Even if it were true that the general public doesn't give a hoot about scientific accuracy, I can't help but think that if these errors were consistently challenged by those of us 'in the know' the public would be better served.

Unfortunately, too many accept and never question what they read or see concerning the sciences. No doubt if science were offered in the same simple, easily digested and entertaining way as the inaccuracies, the public would be more knowledgeable. I think it can be. While it may take longer to find the facts, it takes no longer to present the right information than the wrong.

How can we, as informed professionals who are as meticulous as possible where our Star Shows are concerned, say "it doesn't matter" that some astronomical fact is wrongly presented to the public. No matter what the source, are we serving ourselves or our profession by ignoring even the smallest of unintended errors? Our own conscience should insist that we provide enlightenment and information wherever we see that it is necessary. And of course, we must be ever vigilant about what we present under our own planetarium dome.

Don't wait to get the whole of humanity into your facility to show them the truth. Get out your typewriters, pens, word processors and fax machines and provide corrected information to errant cartoonists and editors. Send diagrams to art directors. Call the local television station which just broadcast the wrong information on that bright "star" in the west. Who knows, perhaps they'll get it right next time because they'll think about it, and maybe even contact you in the future as a resource.

Recently, a well known cartoonist stated in his nationally syndicated strip that winter was approaching because the Earth was moving farther from the sun. Probably 99.5% of those reading the strip considered the statement to be true (cartoonists don't lie!), or never thought to question it. If you were among those who saw this particular strip and recognized the error, I hope your hackles were raised to action. Did you attempt to provide the cartoonist with the correct information? If not, why not?

We can't allow ourselves to generalize that the public and the people who create the misconceptions don't care. They do. In a reply to my letter, the cartoonist promised that if the strip is reprinted he will correct it, and also attempt to be more sure of his astronomical facts in the future (he also indicated that if he had done better in science in school, he probably would not now be a cartoonist!)

Victory! A tiny advance of knowledge onto that vast
field of ignorance has been made, and may influence others. Enough of these tiny advances, and knowledge may overcome ignorance.

We have seen the enemy and they are us, if we sit idly by. So put on your battle helmets and your bandoliers loaded with freshly sharpened pencils, and let's hear the rat-a-tat-tat of your typewriters and printers as you fight astronomical ignorance and inaccuracy wherever you find it.

We have just begun to fight.

Laura Kyro, Producer
McDonnell Star Theatre
St. Louis Science Center
St. Louis, Missouri 63110

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You're right! We are regarded as experts, and why not? Isn't our function astronomy education? We encourage people to make us their source of information. The trouble is, many people think of us as "astronomers," (as in "scientist" or "researcher"), which is not usually true, and that we will be up on everything in the field and can immediately answer any question about anything astronomical.

**My standard response to inquiries is to first understand what they are asking as completely as possible before I give any response.**

The danger here is that it is tempting to answer inquiries immediately, off the top of your head. I have always been more cautious. We serve a very important function, considering how much misinformation there is out there. I have also always worried that I will misinform someone about something and that it will come back to me. That would be not only embarrassing, but would color people's minds about planetariums in general as a source of accurate information.

My standard response to inquiries is to first understand what they are asking as completely as possible before I give any response. Sometimes it takes some explaining for non-astronomy people to get across what they are talking about. Many, many times I will put people off telling them I am not sure of the answer to their question, but I will find out for them and let them know as soon as I can. Some people don't like to be put off, but in the end I've found they are more pleased because I actually went to some effort and spent some time to help them. And confidence in the planetarium as an accurate source of astronomical information remains intact.

As public educators in astronomy, I think it is our duty to provide accurate information—even if it means saying, "I don't know, but I can tell you who else you might try." People will respect you for that too.

An extra effort at accuracy should also be used with respect to our star shows. Again, people expect to see and hear accurate information, unless of course we are clearly dealing with something like science fiction. It is sometimes easy to "fudge" because of physical constraints in the dome, but I believe we have a responsibility as purveyors of astronomy knowledge to the general public. Think about it!

I go to a lot of extra effort and time to make sure what I depict on the dome and what is said in a show is absolutely accurate ... do you?

Garry F. Beckstrom
Robert T. Longway Planetarium
Flint, Michigan

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Jeanne Bishop made some important points in her article about accuracy; I'm sure many of us would be guilty to some of her examples of inaccurate presentations. Just as important, however, is the issue of how we receive accurate information and how to use it in a timely manner.

As director of a small facility, I have a limited budget. However, I feel so strongly that up-to-date and accurate information is necessary to my programming that I spend almost $200 annually on magazine subscriptions. They include Sky and Telescope, Science News, Aviation Week and Space Technology, and several others. Between these and various other sources, it is possible to get a broad view of current astronomy and space science, as well as very current information on astronomical happenings. This information is then used to update existing programs, suggest new show topics, and answer questions from the public and the media. There is no substitute for current, broad-based information.

Of course, this information is useless unless disseminated to the audience in a timely and responsible manner, and here is where it is so easy to get tripped up. Let me give you an example. Recently, an article in Sky and Telescope described findings that the Milky Way and other galaxies may not harbor massive black holes at their cores. Many planetaria have undoubtedly presented the spectre of a huge black hole swallowing
stars at the center of our galaxy, accompanied by spectacular visuals and ominous music. So where does this new information put us? We could just ignore the new study and hope no one sees it; maybe it will be proven incorrect. We could say that the old black hole theory has been supplanted by a new theory. Perhaps the best policy, though, is to use the new theory as a jumping-off point for discussing the suspected new culprit, a pulsar, stressing that this is a possibility raised by new data, but which is yet to be confirmed.

New information and theories can also provide the public with insights on how science and the Scientific Method work. However, we must be careful not to leave the impression that science is a chaotic conflict of ideas that are constantly battling each other for ascendancy. Instead, it should be shown that science tries to paint a grand portrait of our universe, and that occasionally, new brush strokes are added to help complete a portion of the unfinished masterpiece. At times, an artist may slip with the brush, and another will come along to set things right.

Accuracy is the trademark of professionals in any endeavor, and to achieve that accuracy, a constant flow of information from varied sources is absolutely essential. Inaccurate or outdated information leads in inaccurate presentations. As they say in the land of computers, "Garbage in, garbage out".

Greg Rawlings
Sunrise Planetarium
Sunrise Children's Museum
Charleston, West Virginia 25314

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I agree whole heartedly with the premise that we need to be accurate ... with the proviso that we recognize that we are involved in many cases with simulation. ... I don't believe anyone would come to a planetarium to learn about planetary motion in real time.

I would like to comment on the general issue raised by Jeanne Bishop's paper. I agree whole heartedly with the premise that we need to be accurate in what we present with the proviso that we recognize that we are involved in many cases with simulation. We need to be sure that our simulation conveys the correct information or impression to the viewer and is as unambiguous as we can make it. In many cases we might do well to remind the viewer that what we are showing is representational, not the real thing. Consequently, the fact that our meteor shower projector portrays a meteor rate of 10,000 plus per hour is no more distressing than the fact that we increase the diurnal rate by a factor of a 1000 or so and the annual motion by 100,000's. I don't believe anyone would come to a planetarium to learn about planetary motion in real time. When it comes to terminology and hard data, there is no doubt that we have an obligation to get it right.

Thomas Clarke
McLaughlin Planetarium
Royal Ontario Museum
Toronto, Ontario, Canada

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I don't think any planetarian in his or her right mind will disagree with Jeanne's statement, and I think it's a pretty safe bet that no one sets out with the goal of deliberately and maliciously misinforming the audience. On the other hand, we're all guilty of a little carelessness every now and then—how many times have you ever said, "Awww, no one will notice ...?" One of our technicians is always telling me, "In space, there is no up or down, so what does it matter which pole of the planet is up?"

We consider ourselves to be science educators, and we have chosen to communicate astronomy to the general public through the medium of audio/visual theater. We even refer to our planetarium presentations as "shows"—a word which carries with it a certain preconception. Because of this, perhaps, many people expect primarily to be entertained at a planetarium. If they happen to learn something at the same time—well, that's fine, as long as it's relatively painless. We have to recognize that this may mean occasionally being a little more showbiz than scholarly.

For the most part, audiences are already used to seeing time-lapse photography on television and in the movies, so things like speeded up sunsets and sunrises are accepted without any complaints. It's only a short step from there to a fast diurnal roll or to a 1-per-second meteor shower. Still, it helps to tell people what's going on, and as long as you do, there's no problem. If you're discussing the apparent motion of the sky, it would be nice to have stars rising in the east and setting in the west. If, on the other hand, the point is to show closeups of the rings of Uranus, I don't think audiences are really going to care if diurnal motion is running in reverse. If you want to demonstrate the mechanics of eclipses, you won't be able to do it with a
Sun-Earth-Moon diagram that has distances and sizes all in proper scale. The important question here is, what point are you trying to make?

Certainly, we need to be careful about our basic facts - that the Earth rotates (oops!), er, revolves about the sun, or that the moon rotates at all. We should try to avoid putting slides in backwards, and lighting angles on all objects should match reasonably well. But how much dramatic impact does an absolutely silent "Big Bang" have? Do we need to stop and tell our audiences that twenty billion years ago, there was no atmosphere to carry the sound, no orchestra, or no Mark Petersen? How many of us find ourselves trying to think up ways of putting more movement and dynamism into a presentation, of not just running a slide show?

... how much dramatic impact does an absolutely silent "Big Bang" have?

Yes, we need to be accurate, and it's important that the facts we present be correct. Where we're not sure of the facts, we should say so, but we also have to accept that some degree of artistic license and compromise with respect to the point you're trying to make is necessary where the audio/visual experience of the planetarium is concerned.

Bing F. Quock, Assistant Chairman
Morrison Planetarium
San Francisco California 94118

In response to the December '88 FORUM on Volunteers:

Dear Ms. Baker:

Regarding your recent FORUM column in The Planetarian of December '88, I thought that as one of the probable minority of volunteer IPS members I might bring a slightly different point of view to this interesting and important discussion.

I was especially gratified to see the letter from my former "boss," Jon Bell, since I think his positive attitude concerning volunteers really shows in his letter. This positive attitude on the part of administrators and directors is what really counts and sets the tone. If the leadership is experiencing problems with volunteers, the likelihood of problems with the public and/or customers increases.

I cannot address the motivation of school age volunteers, but many adults are interested in feeling needed. Usually this state can be attained simply by listening and being interested in the questions, ideas and opinions of others. All too often I have found "planetarium people" so caught up in their special positions, that they project an "I know something you don't" attitude. This attitude is similar to the smug we/they syndrome one can sometimes experience from resort staff personnel on vacation. In my opinion the larger the organization the more likely this attitude is to exist. A strong volunteer program is a good sign that this situation does not exist. The very presence of volunteers may keep this bad attitude from arising.

One member indicated that they had no volunteers at her planetarium, because paid staff handled everything. That is certainly their choice. It is, however, interesting to note that the Smithsonian, funded by the Federal Government makes substantial use of volunteers.

Volunteers, for the most part, want to be called on, they want to contribute. Staff should take the time to find out specifically what the volunteer can offer by way of interest, time, education, special skills, etc. Staff should not automatically assume that volunteers lack the education or skills to contribute significantly to the planetarium's goals and programs. Volunteer attributes will not always perfectly match what the institution needs; but, if the volunteer is occasionally asked to contribute from his area of interest, he will soon feel part of the team and be willing to undertake other duties as well.

J. L. Frank
USS MISSOURI
FPO San Francisco, California 96689

Editor's note: at a recent non-planetarium conference, an informal discussion was held between two planetarians who were weighing the merits of in-house vs. purchased show productions:

It has been suggested that it is generally 'bad form' for a large planetarium to purchase outside show productions; i.e. in-house productions will be of higher quality than anything purchased. Yet most planetaria can't maintain a staff size adequate to produce "in-house, quality" shows. (A staff of eight was considered a minimum).

If you agree or disagree with this premise, represent a large or small facility, purchase or produce some or all of your shows, your opinions are hereby solicited. To participate in the September FORUM discussion direct your comments to Lonny Baker by July 10.
July 1988, saw a first in astronomy education; the first International Astronomical Colloquium devoted entirely to "The Teaching of Astronomy." Over 130 participants from 30 countries shared ideas for teaching astronomy, from formal courses for astronomy majors to public outreach. The local organizing committee, headed by Jay Pasachoff, arranged a full four day program at Williams College, Williamstown, Massachusetts. These notes will list some of the highlights; the conference proceedings are being prepared by Jay Pasachoff and John Percy for publication later this year by Cambridge University Press.

Beginning with the topic "The Training of Astronomers," Donat Wentzel compared various systems of education throughout the world. Other speakers in this session discussed the curriculum in the United States, Canada, Great Britain, China, Portugal, and India. Basically two systems exist: one emphasizes a four year liberal arts approach at the college level, with a major in astronomy; this is the system in place in the United States. The other (basically British approach), offers a three or four year degree with essentially all course work done in math, physics, and astronomy; in this system, the emphasis is placed on practical experience and projects in the last year. The result is a degree that is the equivalent of a M.A. or M.S. from an American university. It is important to note that in this system students make a career choice at a earlier age, and a lower percentage of students attend university than in the American system. These cultural differences affect the type of astronomy courses offered at the college level.

Courses are also affected by the textbooks available, the next topic of discussion. Following papers on the history of astronomy textbooks by Owen Gingerich and Norm Sperling, a panel of textbook authors got into a heated discussion on the joys and/or sorrows of writing a book. Most of the authors admitted that dealing with the publisher was often the most difficult portion of the process. Author R. Robert Robbins has produced a compilation of all astronomy books published in the last three years and noted that a new book on astronomy appeared every 28 hours!

"Over 130 participants from 30 countries shared ideas for teaching astronomy, from formal courses for astronomy majors to public outreach.

"Practical Work, Demonstrations, and Resources" introduced the place of the planetarium into the teaching of astronomy. Andrew Fraknoi discussed the Astronomy Society of the Pacific slide sets, and requested information from the astronomical community on what we would like to see produced in future sets. Susan Tritton showed the University of Edinburgh Laboratory Teaching Packages, with teaching guides for both astronomy majors and lower levels. The quality of the photographic southern Schmidt plates is wonderful; among the highlights of the collection are Halley's Comet, the Virgo Cluster of galaxies, the Small Magellanic Cloud, and Schmidt spectral plates at two dispersions. The prices are reasonable for such high quality photographs.1 Following the oral papers, there were demonstrations of videotapes, including one by Terence Murtagh showing their use in planetaria. Poster papers and other oral papers highlighted microcomputers in the lab, photometers, CCD's, classroom demonstrations, and methods of teaching astronomy in various settings (community college, large university, clubs ....)
The second day challenged the participants to consider “New Approaches” in the teaching of astronomy. Several papers were presented on misconceptions, on cultural influences, and on using interdisciplinary approaches. Astronomers from all over the world decried the poor cultural education of modern students; Jean-Claude Pecker of France argued for the introduction of art, music, and history in astronomy courses in a multi-pronged attack at the voids in their cultural heritage and science background. Interdisciplinary approaches may be therapy for science anxiety; for example, Sandra Yorka showed how poetry can fit into astronomy classes. The next session discussed the various ways astronomy courses are offered, from lecture to correspondence to television.

Gerrit Verschuur opened the third day with a talk centered on “The Thrill of Discovery”. In interviews with many research astronomers, he found that astronomers do astronomy because they enjoy it, and in order to receive a “high” from a “peak experience.” An astronomer says “yes” to curiosity, and is addicted to the feeling of elation that comes from learning something new. (The “something new” need not be something no one else knows, it can be something just new to the discoverer. For example, discovering how to do a physics problem in high school could offer a peak experience to a student.2)

The main topic of the third day was “Elementary and Secondary School Education.” Darrell Hoff and Philip Sadler discussed Project STAR (“Science Teaching through its Astronomical Roots,” a Harvard-Smithsonian project for developing a high school astronomy course).3 They showed the Pyramid film “A Private Universe” and demonstrated some of the inexpensive equipment that they have developed to help fight misconceptions. Jeanne Bishop gave an invited paper in the Role of the “Committee of Ten” in American education in 1897. She later demonstrated dynamic models in which people assume the roles of astronomical objects. Other participants spoke of the situations in German, Bulgarian, and Polish schools. In a session on “The Training of Schoolteachers,” Lucienne Gouguenheim and her colleagues gave invited papers about the Astronomy Summer Universities held at different locations in France. Since 1977 about 1200 teachers have each spent 10 days making hands-on equipment, learning through lectures, and sharing ideas. A team of astronomers and teachers organize the summer course at different locations, including moving the twelve cubic meters of equipment each time. The summer proceedings are published for reference by the teachers, and a small magazine (Les Cashiers Clairaunt) is available by subscription.4 Also featured in this session were outreach programs, such as that of the American Astronomical Society5. I spoke about my summer programs at the University of Texas, and other workshops for teachers.

“Astronomy in the Developing Countries” was the topic of one panel, with participants from Egypt, India, and Thailand. Participants from Peru, Nigeria, and Malaysia commented on their special needs. Several international projects have been started to help developing countries, for example, the IAU visiting astronomer grants, the Vatican Observatory summer school, and the IAU Travelling Telescope project.

Patrick Moore led off the final day on “The Popularization of Astronomy” with a lively tale of his many experiences, especially in radio and television. Cecylia Iwaniszewska of Poland recognized the efforts of amateur astronomers (IAU Colloquium 98).

“The Role of the Planetarium” concluded the conference. Thomas Clarke spoke of “The Philosophy and Direction of Planetarium Education,” noting that new theories and “high tech” astronomy are more popular with audiences that sky lore. Terence Murtagh commented on “The Planetarium Worldwide;” he spoke of the planetarium as a means of communication, interpreting astronomy for the public. Speakers from several countries gave papers on their efforts to improve astronomy education with a planetarium.

What did this conference achieve? It brought together astronomers and astronomy educators from all over the world and showed them that we all share similar problems. It allowed us to share ideas and to feel excited about trying new ones. It introduced authors to readers, university educators to planetarium educators, producers of television to consumers, scientists from developing countries to scientists from wealthy nations. Everyone shared a common purpose—the education of their audience to the thrill of astronomy.

1. Susan Triton, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, UK.
2. For results from a formal survey see “Survey Probes Tensions between Science and Democracy,” in American Scientist, pp 24-26 Jan-Feb 1989.
3. Project STAR, Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138.
5. AAS Education Office, P.O. Box 3818, Charlottesville, Virginia 22903.
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Reviewed these two books are, both come with $19.95 softbound; $15.95 for two optional disks for IBM-PC computers.


*Telescope Optics, Evaluation, and Design*, Harrie Rutten and Martin van Vrooij, Willmann-Bell, Inc., PO Box 35025, Richmond, Virginia 23235. $24.95 hardbound; $24.95 for optional disk for IBM-PC computers.

Reviewed by John Mosley

These two books are, I hope, a sign of the future—both come with floppy disks. Books, computer programs, and video disks have existed in their separate worlds, but we'll soon see them integrated. And why not—they compliment each other, and are best when used together. These two books are very mathematically oriented, and it only makes sense that they are accompanied by floppy disks that let you manipulate the formulae and work out the problems.

I don't feel qualified to review either properly, expounding on how I would have written them had I been asked, so I'll just describe them and give my impressions. First, both are technical (by my standards) and thorough. They don't seem to leave much out. And they're clearly written by people who know the subject. I suspect that *Telescope Optics* will be the standard reference for advanced amateurs for some years, and the first edition of *Fundamentals of Celestial Mechanics* has been a prominent university textbook for almost 30 years; this revision will carry it well into next century.

*Telescope Optics* is not for the casual amateur and hobbyist who wants to assemble a telescope from commercially available parts. It's for designers who feel at home with ray-tracing formulae and such concepts as Seidel coefficients, linear obstruction ratios, and contrast transfer. This is probably the most rigorous discussion available to the (very) advanced amateur who plans to design his own optical system. There are chapters on: Image Aberrations; Field Correctors; Deviations, Misalignments and Tolerances; Opaquing and Vignetting; as well as specific telescope systems. The accompanying computer programs are for telescope design, lens design, and ray tracing through a variety of optical surfaces.

*Fundamentals of Celestial Mechanics* is a college text. It requires a background in calculus and differential equations, and almost as much acreage is consumed by equations as by text. There are introductory chapters on the celestial sphere and vector mechanics, and then we're off to solving the three and n-body problems, Gauss' method of orbit determinations, Stumpff functions and Kepler's equations, perturbations, and the numerical integration of differential equations. If this sounds exciting, buy the book! The disk contains both procedures and demonstrations.

I applaud Willmann-Bell for marketing quality technical books that have a small market—but a big impact on those who need them.

Reviewed by John Mosley

It is no longer easy to treat all of amateur astronomy in 320 pages. Amateurs have access to such a variety of equipment and do so many things that this reasonably heavy and complete book can give only a few pages each to dozens of worthy topics. Perhaps a truly complete guide to modern amateur astronomy would need to be at least 500 pages long, but such a massive book might intimidate the beginner it is aimed for and be a commercial failure.

It's easy to point out topics where justice was not done. The authors recommend "Norton's Star Atlas"—as outdated a publication as any I can think of—but fail to mention many others that are newer, less expensive, and more useful. CCD and video cameras, which amateurs are beginning to use in California, are not men-
tioned; perhaps they are still rare in England. There is a chapter on observing variable stars, but photometers are dismissed in half a sentence. The authors devote another chapter to describing solar eclipses they have seen, but include only a very short list (and no map) of coming eclipses. The short section on personal computer astronomy programs reveals that the authors are only barely aware that good programs exist or that they might be both fun and useful. I had the overall impression that most of the book could have been written in 1960.

Still, a lot is covered, and most of it quite well. The beginning amateur will find more than enough to digest, and will get many good ideas for observing projects. The advanced amateur will find less of interest. The production standards are high, and the book should find its way into many museum gift shops.

Planetariums are not mentioned—a curious omission that suggests that the authors do not think that planetariums have much to offer people whose hobby is watching the sky. I’d like to think that we have many services to offer, but maybe the authors are telling us something.

Interstellar Matters, Gerrit L. Verschuur, Springer-Verlag, 1989. $29.95.

Reviewed by John Mosley

Would everyone who has produced a planetarium show on interstellar matter please raise your hand? I thought so. Neither have I. Yet Gerrit Verschuur treats this esoteric subject so deftly that, after reading his book, you can see how such a show would work. Gerrit writes about interstellar matter, but more importantly he writes about how science is done. The subtitle, "Essays on Curiosity and Astronomical Discovery," is an accurate description of the purpose of the book. The "essays," however, are tightly linked to tell a coherent story. Note that "matters" in the title is plural.

The book has heroes. Edward Emerson Barnard is the first, and we learn how he first suspected that the dark "holes" in the Milky way that he skillfully photographed might be clouds of opaque matter. He agonized over the problem for the last half of his life, and vacillated between possible solutions. A host of more recent astronomers follow as we trace the enrollment of our understanding of interstellar matter through the 20th century and up to the present and into the future. The emphasis is on how astronomers go about their work, with successes and failures, and it is a very personal story of humans struggling to understand that which is not yet clear. Gerrit writes in the first person when he shares stories of his own participation in the quest to understand the stuff between the stars.

I appreciate Gerrit’s comments on the separation between professional research astronomers and amateurs and planetarians, and how astronomy is communicated to the public. As a former planetarium director, Gerrit has seen it from both sides, and his appraisal is realistic. Professionals are isolated from the public, probably largely by choice, and it falls to us planetarians to interpret their discoveries to the rest of the world. We can thank Gerrit for helping to bridge the gap.

Non-technical and without formulae, Interstellar Matters is a good choice for a favorite armchair or to take on vacation. It’s a good read.


Reviewed by Jordan D. Marché II

When a popular science book is well written, its author justly deserves praise. In The Supernova Story, we are given a very clear and exciting account of exploding stars by a talented scientist and writer. Dr. Marschall, who is Professor of Physics and director of the Gettysburg College planetarium, is also one of "us."

As astronomy/planetarium educators, we should find the opening of the first chapter to be especially relevant. There, the author recalls one of his visits to the Harvard University Museum, where he "could not suppress a twinge of envy for biologists, paleontologists, and geologists, who, by the nature of their subject matter, could assemble such an eye-catching collection of their work." In strong contrast, he notes the difficulties of learning/teaching astronomy that we’ve all experienced: the subject matter is forever out of touch. "If only the fascinating array of celestial objects could be put into glass cases," he laments. The planetariums in which we work are "the closest things to natural history museums that astronomers have." An appropriate analogy, indeed.

It wouldn’t be suitable (or necessary) to detail the contents of this excellent work, because everything of importance is discussed there. Instead, I wish to point out a few highlights that make the work enjoyable and of value to others. The human side of astronomical research is nowhere better illustrated than in the opposing personalities of Fritz Zwicky and Walter
Baade. Yet, their brief 1934 paper "On Supernovae" was in Zwicky’s words [forty years later] "one of the most concise triple predictions ever made in science." At the time, however, it was "just one more crazy idea."

In exploring the cause of Type II supernovae, Marschall uses the analogy of the 'super-elastic bounce' to explain why the outer layers of the star may be ejected so violently. He has even produced a simple but effective lecture demonstration which makes this point clear to anyone. However, I feel that one aspect of the star's core collapse, "neutrino reheating" (p.134), was glossed over too quickly. No explanation is given for where these "thermal neutrinos" (as opposed to neutronization neutrinos) come from.

The Crab Nebula has certainly played a large role in the development of astrophysical thinking. The painfully slow recognition of it being a supernova remnant, and the understanding of its powerhouse in the form of a spinning neutron star (pulsar) are especially well told. From the trail of evidence leading toward it, one wonders why it took astronomers so long to make the final, elusive connection.

Finally, we can enjoy the story of SN 1987A, complete with its odd twists and turns, as a chronicle of how major scientific endeavors are conducted today. It stands as testimony to the power of getting maximum information (and interpretation) out of minimal available data (in the form of photons). It is as close as we have ever come to putting a star in a glass case, and giving it the most intense scrutiny possible.

This is probably the best and most up-to-date general reference on the subject today, and is highly recommended reading. Dr. Marschall's writing achieves a uniform level of technical description--just enough to explain complex phenomena without becoming "jargon." It is a model that many of us should emulate. Anyone who produces a planetarium show on this topic will find The Supernova Story to be an invaluable reference.
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Our second-prize winner in the Eugenides Foundation Script Contest is John Mosley's entry, *On Other Worlds with 'Weatherman.'* Perhaps many of us have already used a local television forcaster in a planetarium show segment, because of the familiarity and popularity of that person's character with our audiences. John has extended this idea and used it as the connecting theme for a look at the diverse weather systems on other worlds. Through the proper use of entertainment, he takes what could otherwise be a 'dry' subject, and turns it into a lively review that audiences can relate directly to. And that should be one of our prime objectives when preparing any planetarium show.

On Other Worlds With "Weatherman"

John Mosley
Griffith Observatory
2800 East Observatory Road
Los Angeles, California 90027

The idea for this show was not mine. Dr. George Fischbeck, the local ABC-TV Weatherman and a popular Los Angeles celebrity, approached us with the idea of cooperating to produce a planetarium show about weather on the planets. Dr. George (as he is affectionately known) is an earth scientist who has always had an interest in presenting science to the public, and a planetarium show had long been on his mind. We were only too glad to cooperate, and the script you see here is our planetarium show version of that effort. The original title of our show was "On Other Worlds With Dr. George."

I like the show for several reasons. First, it provides the human touch that is so important to presenting abstract concepts. Dr. George comes across as an individual whose personality shines through. He shares his feelings and his sense of what is important. He provides needed perspective. Second, he does not take himself too seriously, and his sense of humor nicely balances the substantial amount of hard science we present. He keeps the audience from getting tired. Third, he gives a second perspective to the show who contrasts with (while complementing) our Observatory narrator. And lastly, using a well-known local recognizable personality only helps with publicity.

I should mention that, except for taped audio and video segments, Griffith's shows are presented live by a skilled narrator, or lecturer. This may seem old-fashioned, but I wonder. We feel that people have plenty of exposure to canned entertainment experiences and that they appreciate hearing somebody live for a change. More importantly, we also feel that our live voices provide a sense of presence and spontaneity that is lacking in too many taped shows. As written, this show is a dialogue between a live narrator and a local celebrity weatherman.

Because our shows are presented live by knowledgeable narrators, a few sections of the script are not written out in full. Were the show to be presented entirely prerecorded, these sections would have to be completed or deleted. I think they'll pose no challenges to crack scriptwriters.

Dr. George appears both on audio tape and video tape. We incorporate video segments into our shows but limit their length to a few minutes at a time. People have plenty of opportunity to see video at home, and we like to offer them something different. Institutions lacking video could present this show using audio only (or perhaps substitute 16mm film for video).

This script was partially rewritten to eliminate references that are specific to Los Angeles and to Dr.
George. In our version, for example, Dr. George does not hold a small telescope when introducing the moon; he stands in front of our 12-inch Zeiss refractor; also, our panorama (last page) shows Los Angeles as it would appear were sea level to rise by 300 feet. You should customize the show to emphasize your own location and the personality of your own weatherman. Such customization is an important part of the show, but it doesn’t translate directly from city to city and personality to personality.

On Other Worlds with "Weatherman"

Audio and visual cues are listed in the left column; the text is in the right.

People who want to hear what the show sounds like when presented live at Griffith can send a blank 120-minute cassette and return postage for a taped copy.

—John Mosley

The Planetarian, Vol. 18, No.2, June 1989
town of Barst, Guadalupe, when 1½ inches of rain fell in just one minute. If that had continued, they'd have been under 7 feet of water one hour later.

That's hard for us to imagine, but it would be even harder to imagine for the people in Calama, in Chile's Atacama Desert. It hasn't rained there in over 400 years.

Imagine this: in Browning, Montana, the temperature once dropped from a cool 44° to a frigid -56° overnight. I wonder if their weatherman predicted that, and if they believed him. The sharpest heat-wave on record hit Spearfish, South Dakota, when the mercury rose from 4° below zero to 45° above zero—in just two minutes! Even my microwave doesn't warm things that fast!

NARRATOR

If we think that's bad, on other worlds it's far worse.

VENUS WEATHERMAN

Today's high will be 900°, with the overnight low also 900°; it'll be the same tomorrow. The barometric pressure is remaining constant at two thousand seven hundred inches. Winds are a steady 1 mile an hour out of ...

MARTIAN WEATHERMAN

This morning the North Polar Cap began to thaw, and the polar winds are picking up. Gusts should reach nearly the speed of sound. The high today will reach 100° below zero with the warming trend continuing on through ...

LUNAR WEATHERMAN

Expect another long, cloudless, sunny day on the moon. Lows this morning were 200 below with highs expected to reach 220 above. The cosmic radiation index is high, so don't forget to take your lead umbrella. In the long range forecast, we can expect meteor showers starting at the end of the month ...

HALLEY'S COMET WEATHERMAN

That strange bright thing is called the sun, and we don't see it too often around here. It's getting closer and things are starting to heat up. The air, which has been safely frozen solid for a long time, is starting to thaw, and it's shooting up out of the ground in high speed jets. Keep small children away from those jets! The atmosphere will be around for only a short while, but in the meantime we'll just have to get used to it. Look for warmer days with increasing clouds ...

NARRATOR

And so the earth does not have the strangest weather in the solar system—not by a long shot. With "Weatherman"'s help, we'll see some pretty strange things on the other planets.

Let's start by taking a good look at our own atmosphere.

The most common thing we see in the air is clouds. Clouds can take on an extraordinary variety of shapes—they can be truly beautiful.

[The audience sees many visuals of beautiful clouds to music but without narration.]

There are rarer, more sublime atmospheric sights that are caused by the interplay between sunlight and water in the air. The most familiar of these is the rainbow.

A rainbow is sunlight that has been bent by raindrops. White light is really made of all the colors you can see, as you can demonstrate by sending a beam of sunlight through a glass prism. The different colors are bent a different amount as they go through the glass, and this separates the colors. A
similar thing happens when sunlight goes through a water droplet of the right size. The light is bent as it goes in, is reflected off the back of the droplet, and comes back out broken into its component colors. You see a rainbow.

Ice crystals in the upper atmosphere break up light in a similar way and create beautiful rings in the sky. If the ice crystals are short and thick, they create a halo around the sun or moon. If the ice crystals are flat, they create a sundog or moondog—a bright concentration of light at the same elevation as the sun or moon and 22° from it. Sometimes the sundogs are almost as bright as the sun itself, and then they're called "mock suns."

The best place to see sundogs is from the Arctic—the land of the midnight sun. There, multiple sundogs can ring the horizon in a sight you'll never see from back home.

There's something else you can often see in the Arctic that you'll rarely see from as far south as we are. That's the northern lights, or the aurora borealis. As we understand it, the aurora happens when atomic particles are blown off of the sun. They hit electrons that continuously orbit the earth as our Van Allen Radiation Belts, and they knock these electrons out of orbit. The electrons smash into the air molecules high above our heads, where the air is so thin it's almost a vacuum, and the air glows like a fluorescent tube. The shimmering curtains and rings change shape as the atomic wind from the sun blows against the radiation belts. This can happen so high up that the space shuttle orbits inside the aurora.

And so there are wonderful things happening in our air. It pays to keep looking up.

The most obvious thing about our air is so obvious that we don't even think about it. But kid's notice. It's one of those questions grown-ups just love to be asked:

**CHILD**

Why is the sky blue, "Weatherman"?

**"WEATHERMAN"**

Well, ... I'm glad you asked that.

Good question! I think I can explain.

White sunlight is made up of all the colors of the rainbow, from blue through green, yellow, orange, and red. When sunlight goes through the air, the air molecules and dust particles scatter the light waves in all different directions. The red and yellow sunlight comes straight through, but the blue light is scattered more than the other colors. It's spread around the sky. So the light we see scattered off the air is blue.

Now let me ask you a question. Do you know why sunsets are red?

**CHILD**

No.

**"WEATHERMAN"**

Well, it's for the same reason. When the sun is low in the sky, the light that reaches our eyes has traveled a long way through the atmosphere, and almost all the blue light is scattered away. What is left is red. The more dust in the air, the redder the sunset. You should see a sunset after a grass fire or forest fire. Then it is really red.

Would you like to see a sunset?
Day & Night city pans
sunset colors
moon, planets, stars
on dim
blues to low

N. America at night
World at night

On a clear night in our town you can see perhaps two dozen stars, and that’s about it. The problem isn’t the smog because on many nights there’s no smog at all. The problem is the lights. There are so many lights in this city of ours that they light up the sky at night like the sun does during the daytime, and they bathe us in perpetual twilight.

It wasn’t always like this. Before electric lights, the sky was dark at night from even the largest cities. All that has changed, now, and from most urban areas the Milky Way is a dim memory.

Now large parts of the world never experience true darkness, and for many people who grow up and stay in the cities, the once-common dark night sky is as remote as the Sahara desert. But it is accessible, and today if you go camping away from town, where there are no lights, you can still see the sky as it was meant to be seen.

To paraphrase the poet Emerson, if the stars should appear only one night in a thousand years, how people would anticipate and remember their beauty for many generations.

Yes, a black sky filled with stars is one of the most spectacular sights in nature. But, by living in brightly lit cities, we’ve lost our view of the night sky.

When we look into the night sky, we see so many stars ...

Venus

Venus is so brilliant because it’s permanently covered with a thick layer of clouds. Those clouds, however, are deadly—they’re totally unlike the fluffy things we’re used to on earth. And they’ve completely altered the environment of Venus.

If we could descend through the atmosphere, we’d find a world very different from our own. “Weatherman” will guide the way.
As we drop towards the surface, the first thing we'll notice is a haze of ice crystals about 90 miles high. It's pretty cold up here, as it is on the earth at the same height, and the winds are a terrific 220 miles per hour. Our spacecraft heat shield is beginning to glow, and we're slowing down.

At 40 miles up we plunge into a thick layer of haze, but there's no water vapor here. These clouds are made of droplets of concentrated sulfuric acid! The droplets fall as acid rain—real acid rain—but as they descend they get warmer, evaporate, and rise again as vapor. There's a continuous drizzle of sulfuric acid on Venus, but it never reaches the ground.

Closer to the ground, it gets warmer, the winds die down, and we pass through a series of monotonous sulfur-colored bands of haze. Lower still and we break through the haze layer. The air from here to the ground is clear, but it's so thick we can't see through it. The sky is murky, like a heavily overcast day back on earth, and has a gloomy reddish cast to it.

By the time we reach the surface, the air pressure is 90 times higher than on earth—high enough to crush a submarine—and the temperature is an incredible 900°Fahrenheit. It's like being at the bottom of an ocean of hot acidic gas. And it's the same from pole to pole, day after day.

NARRATOR

The atmosphere of Venus is so hostile that the first Soviet craft that tried to land there were crushed and burned while still miles above the surface. Later spacecraft were dropped from orbit without a parachute, but the air slowed them down so they landed gently and survived. The Soviet spacecraft photographed a barren, rocky surface.

"WEATHERMAN"

By the way, but there's a good story about the little windows on the American spacecraft that landed on Venus ten years ago. The air is so corrosive that the windows had to be made of sliced diamond! NASA paid a heavy customs duty when they brought the diamonds into the country, and the tax would be refunded only if the diamonds were exported again to another country. But Venus wasn't on the list! NASA couldn't get a refund until a court ruled that, for customs purposes, Venus is indeed a foreign country.

NARRATOR

There's a 13-carat diamond and some smaller ones just sitting on Venus.

Venus as swamp; Man from Venus

Thirty years ago we knew almost nothing about Venus. We speculated that it might be covered with swamps filled with primitive reptiles, and some people with overly active imaginations even wondered if there might be people there.

Then spacecraft arrived, and we began to find out what it's really like. The biggest surprise was just how hot the planet is—it's hot enough to melt lead. It's so hot not because Venus is close to the sun, but because the atmosphere is made of carbon dioxide.

Here's some carbon dioxide. If I shake this can and then open it, you know what'll happen. A gas will come fizzing out and it'll make a royal mess. That gas is carbon dioxide, and its under pressure inside this can. You also breathe out carbon dioxide every time you exhale.

The atmosphere of Venus is almost pure carbon dioxide, and that gas makes the planet hot through what we call the "greenhouse effect." You're familiar with the greenhouse effect if you've left your car parked in the sun on a warm day.

"Weatherman"—would you explain how it works?

"WEATHERMAN"

Where I'm sitting it's very warm. It may be only 80 degrees outside, but in here it's 130!

It's hot in here because some of the light that gets in is changed to heat, but that heat can't get back.
out. Think of sunlight as being made of three different kinds of light: ultraviolet, visible, and infrared. Ultraviolet light is bluer than blue—we can't see it, but it gives us those golden suntans. Infrared light is redder than red and we can't see it either, but we feel it as heat. Visible light is made up of all the colors we can see. When light hits the windows of your car, the visible light goes through but the ultraviolet and infrared light are stopped by the glass. When the visible light hits the seats and dash, some of it is changed to infrared light. That infrared light can't get back out for the same reason it couldn't get in in the first place: it doesn't go through glass, or at least not very well. The heat builds up inside the car and it gets mighty hot inside. That is why greenhouses are such good places to grow things in chilly climates. That's also why you should never leave children or pets unattended inside a car while you go shopping.

On Venus, the carbon dioxide in the atmosphere has the same effect as glass. It lets light in, some of the visible light is changed to infrared, but the infrared can't get back out. The temperatures build higher and higher to incredible levels. The air is so thick that it distributes the heat uniformly over the entire planet, and so the temperature is the same everywhere. There are no seasons, so the temperature doesn't change.

NARRATOR

So Venus is hot because of the carbon dioxide in its atmosphere, not because it's close to the sun.

With so little change, a weather report on Venus would hold few surprises. It might sound something like this:

"WEATHERMAN"

It's hot and cloudy. The high today will reach 900°. In the desert the temperature will soar to 900°, while in the mountains it'll climb to only 900°. The high smog shows no sign of clearing. Tomorrow expect more of the same. I predict highs near 900. The lows should ...

ANCHOR

Now wait a minute, "Weatherman"! You've been doing the weather for fifteen years, and every one of your reports is exactly the same. Enough's enough! Can't you find something new to say?

"WEATHERMAN"

You know, he's right. But I don't make up the weather—I just report it.

NARRATOR

Thank you, "Weatherman." With no change in the weather most of the weathermen on Venus are probably unemployed!

So what would a sunset look like on such a planet?

First, from Venus you can never see the sun or stars. The haze layers are so thick that sunlight filters down as a sort of diffuse glow, like an overcast day on earth, but you can't tell where the light is coming from. Second, Venus takes 243 earth-days to spin once on its axis. For some reason which we don't understand, Venus spins very slowly and one of its days lasts about 8 of our months. That means that the sunrises and sunsets are awfully slow. Third, for another reason we don't understand, Venus spins backwards. The sun rises in the west and sets in the east.

So a Venus sunset would not draw a crowd. Week after week the sky would slowly grow gloomier and grayer, but the colors wouldn't change and you wouldn't even know in what direction the sun was setting. Eventually it would get dark, but no moon or stars would appear to relieve the monotony of the long night ahead. This is a typical night on Venus.

There's a place closer to home that's a total contrast to Venus. It too has sunsets, and although it doesn't really have weather as we normally think of it, it does have an environment. That place had never been visited until 20 years ago.

The Planetarian, Vol. 18, No. 2, June 1989
As I watched the first astronauts walk on the moon, I was struck by the utter loneliness of the scene. "Magnificent desolation," they said, and it is. There is very little color, no movement, and no life. But still—it has its own stark beauty.

There are no stars in the sky. I had always wondered about that. You should see stars during the daytime on the moon, I reasoned, because there’s no air and the sky is perfectly black. But I hadn’t thought about sunlight reflecting off the surface. The glare off the rocks makes it impossible to see stars during the daytime unless you shield your eyes from the ground. Then you can see stars.

I noticed how black the shadows are. That I’d expected. On earth, air diffuses the shadows and the light from the bright sky fills them in, but here with no air the shadows are as black as black can be. The astronauts reported that they had to be careful where they stepped when they walked into a shadow.

Of course, for me the most impressive thing of all is the beautiful little blue-green earth just sitting so far away in that black sky, wrapped in bright white clouds. It’s quite a sight for an old weatherman.

Because the sky is black "24 hours a day," the moon would be a great place for an astronomical observatory, and for years people have suggested putting one there. It makes a lot of sense—from within a dark observatory dome that shields you from the glare of sunlight, you could observe the stars around the clock—and clouds would never get in the way. Someday this where all the major observatories might be.

With no air molecules to scatter the sunlight and no clouds, you might think that a sunset on the moon would be pretty unexciting, and that is correct. The moon takes about 28 days to turn once on its axis, so a day there lasts 14 earth days and a sunset is a pretty drawn-out affair. The sun slowly moves towards the horizon and eventually disappears. That’s it—there’s no color, no clouds—no fanfare.

No one has yet seen a sunset from the moon, but people have seen sunsets on the moon from the earth. You can, too, if you have a small telescope. "Weatherman", would you explain?

You can see the moon surprisingly well through even a small telescope like this. Through a telescope you can see craters, dark lava seas, mountains, and shadows.

There’s no air to blur their edges, so the shadows stretch all the way to the far horizon. As the sun rises, the shadows grow shorter. In this time lapse view, days go by in seconds, and you can actually watch the shadows grow shorter and disappear as the sun rises.

It’s always sunrise somewhere on the moon, and any clear night that the moon is out you can watch a sunrise frozen in motion.

The moon is the symbol of romance. [pause for audio]

The moon has inspired music, art and poetry, but the romance diminishes once you get there. No one is ever going to travel to the moon just to watch a sunset. And the moon is typical of all those many worlds that have no atmosphere.

It turns out that there is only one other planet in our entire solar system that has a sunset even remotely comparable to earth’s. Can you guess which? [Pause; then cue Mars zoom.]

Mars is the most earth-like of all the planets, but even so it’s not very pleasant. It’s farther from the sun than the earth and so it’s colder, and it’s smaller than the earth so its gravity can not hold on to much air. It’s basically a cold, barren, rock-strewn desert.
When I was young, Mars looked more hopeful. We thought there was enough air to make the temperature hospitable, and we thought there might be life. I read all those science fiction stories about Mars and watched the Flash Gordon series every Saturday afternoon. You could grow up in those days believing that there really were Martians.

It was a romantic image, and it sure would have been nice if Mars had turned out to be more like Lowell's vision. Alas, such is the truth of hard reality. When the Viking spacecraft landed in 1976, this is what it found.

Mars is a barren rocky desert. Lowell's canals were optical illusions. There are no Martians now, there never have been, and there won't be until we go there and set up shop sometime early next century. There are young children alive today who will one day live and work on Mars, and then they'll be the Martians.

Mars has a thin atmosphere composed almost entirely of carbon dioxide, the same gas that makes up the atmosphere of Venus. Mars, however, has precious little of it. The barometric pressure is about one-half of one percent of the pressure at the surface of the earth—equivalent to the air pressure at 100,000 feet, or 20 miles. You couldn't live on Mars without a spacesuit.

Because the air is so thin, it's cold on Mars. "Weatherman" will tell us how cold.

It's real cold. On earth, the temperature drops when the sun sets. It might be 90° during the afternoon on earth, but in the wee hours of the morning it might drop to 60 or so.

When it's humid, the temperature doesn't drop nearly as much at night because the humidity in the air holds the heat. Dry, thin air can hold less heat.

Mars has virtually no water in its air, and it doesn't have much air. So, at night, the temperature goes way down. It might hit 20° or so on a sunny afternoon afternoom at the equator, but by midnight the mercury falls to a frigid 180° below zero! And that's in the summer! In the winter, temperatures drop as low as 230° below zero. That is so cold that if you dropped a banana, it would do this.

(Pulls banana (frozen with dry ice) out of box and shatters it with hammer.)

The message is clear: don't leave your fruit outside overnight if you're a Martian. That's how cold it is on Mars.

It's cold on Mars because the air is thin, not because Mars is far from the sun.

If Lowell had realized how thin and cold the air is on Mars, he wouldn't have been so enthusiastic about his Martians. But we didn't know. Years ago we thought Mars had a substantial atmosphere and a blue sky. When we realized how little air there really is, we thought the sky would be deep blue. Then we went there and found that it's really pink!

The pink color comes from suspended dust particles. Have you noticed how clean the air looks after
red sky glow
pan dims to low
sunset colors
sun (slew)
stars, tiny earth
Phobos (slow slew)
point out if necessary
point out
Venus, Mars, Earth;
all else fades
“graphs” under
Mars and earth;
flat graph under Venus
earth upright
earth tilted
Proj. daily & annual
motions synchro-
nized to keep sun
on meridian

it rains? It never rains on Mars, so the dust kicked up by desert sandstorms never completely settles out. The dust has a reddish color—that’s why Mars is the Red Planet—and it gives the sky a pink color.

The cameras aboard the Viking spacecraft photographed many martian sunsets, so we know what they look like.

[Do not talk during the sunset.]

Mercury, Mars, and Pluto are the only three planets in the solar system, other than the earth, from which you can see the stars. With the thin air and infrequent clouds, the martian sky should be a beautiful sight.

[Note that the martian constellations are the same that we see from earth.]

Here’s something else you’ll never see from earth. Can you guess what it might be? [Pause.] It’s the earth. Just as Mars is a planet in our sky, the earth is a planet in the martian sky. As seen from Mars, the earth is as bright as Jupiter is to us. The moon looks like a medium-bright star that sits right up against the earth like a close double star. The moon orbits the earth each month, so Martians see the moon first to the left of the earth and then to the right. Tonight, as seen from Mars, the earth and moon are in [constellation].

As seen from earth, Mars is now in the morning sky where it rises at about xx:00. We’ll get a great view of it late next summer. Then Mars will be the brightest object in the early evening sky. Mars comes closer to earth this September than it has been since 1971, and then it’ll be a grand sight.

[Substitute a description of where Mars is and will be when your show is presented.]

And so we’ve seen that the atmospheres of Venus and Mars are quite unlike the earth’s and that, consequently, they have weather that is unlike anything we’ll ever experience here. On Venus, the weather doesn’t change from day to day; on the earth and Mars it does. It changes because we have seasons. Seasons happen for astronomical reasons we can easily visualize and understand.

Basically, we have seasons because the earth is tilted on its axis. If the earth sat upright in its orbit, the sun would always shine down on the equator. The equator would be hot, the poles would be cold, but things wouldn’t change much from day to day or month to month. January would be like August.

Because the earth is tilted, the sun crosses high in the sky in summer, and low in the sky in winter. The amount of heat we get from the sun changes from month to month.

Let’s see how this looks from our own backyard.

[Run the sky forward in daily motion, explaining what is happening, and bring up the sun. Mention that on Venus the sky turns 243 times slower. Note where on the horizon the sun rises. Continue rotating the sky until the sun is on the meridian, bring up the meridian, and note the sun’s height. Then run both daily and annual motions synchronized to keep the sun on the meridian. Run until next spring or summer, pointing out how the sun’s noontime elevation reaches a minimum on December 22 and a maximum on June 20. When the sun is low, it’s light is spread over a larger area and the days are short: that’s why it’s cold in winter.]

And so the important point is that we have seasons because the earth is tilted.

How are seasons different on other planets?

Venus

Venus is tilted only 3 degrees, so it has no seasons. The weather probably wouldn’t change from day
Mars, however, is tilted almost exactly the same as the earth. It has real seasons and dramatic seasonal effects. [Pause, and cue dust storm.]

"WEATHERMAN"

Oh, boy, here comes a martian dust storm.

I’ve heard about these storms all my life. It’s so cold here that the air freezes out of the sky during the winter and sticks to the polar cap. Come spring and summer, the air evaporates again. Terrific winds blow as about a quarter of the atmosphere wooshes to the opposite pole at almost the speed of sound. One huge dust storm gets kicked up along the way. Once it starts, it builds up until it covers the entire planet, and you can even see it from earth. The dust doesn’t settle out for weeks or months. The air never clears completely. That’s why the sky is pink.

NARRATOR

Dust storms happen at the same time each martian year, so we can predict them in advance. Right now on the northern hemisphere of Mars it’s summer, and autumn begins on April 18, 1988. [Revise dates for current apparition.] The winds build up when the South Polar Cap thaws during the summer. If there is going to be a global dust storm, it’ll start near the time of the martian summer solstice on September 11, 1988. Here’s a set of photographs taken few days apart during the buildup of the dust storm in 1973. The arrow shows where the storm begins. It takes about three days to going, the winds pour dust into the stratosphere for another ten days, and then it slowly clears during the next month or so. During a dust storm the planet looks pretty bland through a telescope.

So the seasonal changes do have a profound impact on Mars, just as they do on the earth.

Now, the earth’s seasons would be of equal length if our orbit were perfectly circular. It isn’t, and our seasons are of slightly different lengths. Summer is 4½ days longer than winter. Mars, with an orbit that is more out-of-round, has seasons that of more unequal length. But the record for lop-sided seasons goes to comets.

Comets travel on orbits that take them very far from the sun and then very close. When they’re far, they’re frozen solid. As they approach the sun, they begin to thaw. A comet is made of a mixture of dust and ice, and as the sunlight begins to warm it, the ice evaporates and forms a temporary atmosphere and a long and beautiful tail. So—one unusual thing about comets is that their atmospheres are temporary—they don’t remain around very long. The air spurts out of cracks in the ground in high speed jets. Another unusual thing about comets is the lengths of their seasons. Take Halley’s Comet as an example.

Halley’s Comet rotates and its axis is tilted, so it too has days and seasons. But because its orbit is so far out of round, the seasons are of wildly different lengths. Summer lasts 72 years, but winter lasts only 1 month!

In the case of Halley’s Comet, the seasons have nothing to do with the “weather,” and this is an odd concept. Remember, by definition it’s summer when the sun is high in the sky, but that has nothing to do with how close you are to the sun. The earth is actually closest in January—in the middle of winter—but it doesn’t make much difference because our orbit is nearly circular. In contrast, Halley’s Comet comes to within 55 million miles of the sun at closest and 3½ billion miles when farthest, and that is a real difference. Its weather depends on how close it is to the sun, not what season it is. Winter just happens to come when it’s closest to the sun and has its warmest temperatures.

And so we’ve seen that, as strange as things sometimes seem to be on earth, they’re far stranger on other worlds. We had no idea, until recently, just how much variety there is among the planets.

Nor did we realize that atmospheres change—or that we’re changing ours. Only recently have we begun to appreciate how vulnerable our air is and how quickly conditions can change.

Your deodorant no longer contains fluorocarbons because they were banned from spray cans about ten years ago when it was found that they’re harming the ozone in the upper atmosphere. Ozone is a
Antarctica

type of oxygen, and it protects life on earth from damage by ultraviolet radiation from the sun. A few years ago researchers discovered a seasonal thinning of the amount of ozone over Antarctica—the famous ozone hole. No one knows why it’s there, but the hole has been getting bigger each year for the last several years.

smokestacks pan

Even worse, we’re burning the earth’s reserves of fossil fuels — coal and oil — putting an enormous amount of carbon dioxide in the atmosphere. In the last century we’ve increased the carbon dioxide content by 25 percent. The question is, what is this going to do?

Carbon dioxide causes the greenhouse effect. It makes Venus the hottest planet in the solar system. It has the same effect on our planet. The earth is one or two degrees warmer than it was a century ago, and the rate of warming is increasing. The carbon dioxide level may double in the next century, and if it does, the polar ice caps will begin to melt and sea level will rise.

Venus would be more earth-like if it had less carbon dioxide. Venus is a warning—it shows what can happen to a planet when the greenhouse effect runs out of control.

“Weatherman” would like to share his final thoughts.

“WEATHERMAN”

As we learn more about the mysteries of other worlds, let’s put that knowledge to good use! Let’s not forget that our own planet earth is the most precious jewel in the solar system. Of all the planets, this is the only one whose future can be shaped and guided by intelligent life—that’s us. Let’s try to take better care of this tiny, fragile world, with its air, land, and water that are so vital to all living things.

You know, the earth didn’t come with a money-back guarantee. If we break it, we’ve got to live with it.

We hope you’ve enjoyed visiting other worlds, and here’s hoping that your forecast is a bright one!

(Selecting, continued from page 19.)

The Budget

With most of this equipment being imported from overseas, it’s important to protect your budget with enough funds to cover fluctuating exchange rates. About 20% was built into the budget for the exchange rate uncertainty. This flexibility was necessary, as the prices actually increased about 20% during the seven months between the initial price quotes and actual purchase.

We also included funds to pay two people to work on the computer program during the summer and to make revisions in the nonattendance periods during the first year of use.

Laser disc and video technology opens new horizons to the planetarium function. The results are exciting, and with this new technology we see students level of learning and interest on the rise. One major problem with the quantity and quality of images on the discs is to know when to quit. In merely nine months of use, the integrated system already serves a major function in our facility. Should you desire further details about our project, please contact me at the address at the beginning of this report or by phone at 312-851-7900.

Mark your calendars

The final deadline for the September issue of The Planetarian is July 21

The Planetarian can now accept articles by FAX. Call John Mosley (213-664-1181) for the current FAX number.
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ALL RIGHT, KROCK!

WHY DOES BUBBLES BANDERA WORK LATE IN THE PLANETARIUM? WHO APPROVES YOUR BUDGET? WHAT'S THIS ABOUT YOU AND SOME WAITRESS? WHAT HAPPENS TO TICKET MONEY?

DEAN 6-89
WHERE IS THE ASTRONOMY?

Astronomy has furnished the keys that have unlocked the treasures of the other sciences, which in turn, have produced rewards beyond the imagination of the astronomers who provided the keys. Astronomy established that scientific information comes from observing and measuring things rather than the untested contemplation of philosophers and theologians. Astronomy has continued to be a laboratory for physics and chemistry. Astronomers know they have only scratched the surface of what there is to be observed. More observatories with much more powerful instruments are needed to pursue these mysteries. America's astronomy program, which was at its zenith during the height of the space program, was meager even then. Only Texas and California gave meaningful state support to astronomy. Our orbiting telescope has such a low priority than its launching date is yet to be firmly set. To argue that private philanthropy and the government should not be investing in astronomy until we can overcome poverty and human need would be like arguing that we should not invest in manufacturing antibiotics until we have spent the money it takes to cure pneumonia. How many must suffer because we are postponing the knowledge and blessings that astronomy can bring for humanity? Yet it is tough to find either gifts or tax money for astronomy in times like these. We know from experience that astronomy produces enormous blessings previously undreamed. (Permission from John Wildenthal, McDonald Observatory Board Member)

WHO'S ON FIRST?


HAVE YOU HEARD

How Astronomy Day came out? Kudos to Gary Tomlinson of the Roger Chaffee Planetarium, Grand Rapids, and Steve Dodson of the Science North Science Centre in Sudbury for being coordinators for United States and Canada respectively!

MARK YOUR CALENDARS

- June 21-25 CENTENNIAL MEETING OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC, Berkeley, California (415 337-1100 for information)
- June 26-30 BIENNIAL CONFERENCE OF PLANETARIUM ASSOCIATION OF CANADA, Montreal Quebec (514 872-3611 for information)
- June 27-29 ANNUAL CONFERENCE OF THE CANADIAN ASTRONOMICAL SOCIETY, Montreal Quebec (604 388-0008 for information)
- June 30 - July 3 ANNUAL GENERAL ASSEMBLY OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA, S igney, Nova Scotia
- July 3 INTERNATIONAL PLANETARIUM SOCIETY COUNCIL MEETING, Athens, Greece
- July 4-5 THIRD EUROPEAN PLANETARIUM CONFERENCE, Athens, Greece (Dionysios Simopoulos, Eugenides Planetarium, 387 Syngrou Avenue, Paleo Faliro 175-64, Athens)
- July 9-13 SECOND BIENNIAL PROFESSIONAL PLANETARIUM PRODUCTION WORKSHOP, Bishop Planetarium, Bradenton, Florida (813-746-4132 for information)
- July 10-14 SPITZ SUMMER INSTITUTE I and WEST CHESTER UNIVERSITY, "Naked i Astronomy", Chadds Ford, Pennsylvania (215 459-5200 for information)
- July 17-21 SPITZ SUMMER INSTITUTE II and WEST CHESTER UNIVERSITY, "Teaching with the Planetarium", Chadds Ford, Pennsylvania (215-459-5200 for information)
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• July 24-28 McDonald Observatory 50th Anniversary, "Frontiers of Stellar Evolution", Alpine, Texas (512 471-3000 for information)

• October 18-21 Annual Conference of the Great Lakes Planetarium Association, William M. Staerkel Planetarium, Champaign, Illinois (217 351-2568 for information)

DID YOU REGISTER

• Between June 18 and August 18 (for two weeks) NASA Educational Workshop for Math and Science Teachers, Ames Research Center, Goddard Space Flight Center, Kennedy Space Center, and Marshall Space Flight Center

• Between June 18 and August 18 (for two weeks) NASA Educational Workshop for Elementary School Teachers, JPL, Johnson Space Center, Langley Research Center, Lewis Research Center, or Stennis Space Center.

REMEMBER

• June 24 Uranus is at opposition at magnitude 5.5
• June 26 Vesta, the brightest asteroid, is at opposition
• August 17 Lunar eclipse

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• August 25 At Neptune, Voyager 2 makes its last planetary encounter what a thrill that launch was in August of '77!

• September 5 Pluto reaches its first perihelion since the 1740's

Wichita Planetarium Director Celebrates 20th Anniversary

Jose Olivarez, Director of Wichita's Omnisphere and Science Center, celebrated his 20th anniversary as a planetarium director in March by taking a trip to the southern hemisphere to see the southern sky. Jose went to Santiago, Chile, where he was the guest of Carlos Rios, Director of the University of Santiago Planetarium. So impressive was the viewing that Jose has scheduled a return to Chile next February to visit the famed Cerro Tololo Observatory, Las Campanas Observatory, and the La Silla Observatory (European Southern Observatory). Write to Omnisphere and Science Center, 220 South Main, Wichita, Kansas 67202 if YOU want to be included! Jose and Carlos are hoping for a small contingent of visiting astronomers so don't say you weren't invited!

BIG NEW STAR

On April 1, 1989, the new Museum of the Rockies, Montana State University, Bozeman, opened to the
public. The $9.5 million needed for construction, equipment, exhibits and programs had been raised through private contributions! The Museum of the Rockies is truly a gift for the people of Montana during its Centennial year from the generous people who have supported it. Director Jim Manning gives sky shows in the Taylor Planetarium then walks the audience out the door a few yards and literally shows them what they just saw!

HAVE YOU HEARD
The planetarium at the Top of the World opened in May? The Northern Lights Planetarium in Tromso, Norway, with a 69.5-degree latitude will make it the northern-most planetarium on the globe! Carolyn Collins Petersen, RMPA, is on the task force from Colorado to select names for NASA's orbiter! Phyllis Pittuga reports from the Adler Planetarium about their first ecology show entitled FRAGILE EARTH. Look for Phyllis' ANCIENT ASTRONOMY in the very near future. Fulbright scholar Phyllis has been doing research in Peru and has helped to uncover (literally) an ancient observatory. Her MYSTERIES OF THE MILKY WAY, running currently with FRAGILE EARTH, show the Peruvian influence of very clear skies at 13,000 feet! The Adler Observatory has been tracking Pluto with the 20" - leading into their fall show SEARCHING FOR PLANET X with Clyde Tombaugh, himself. I was impressed with an old-new exhibit about your weight in outer space. Instead of the scales there are now space transporters which 'beam' you up to celestial objects. Voices are heard via fiber-optics with the information! In you live near Chicago you might investigate Adler's evening courses. Professors from University of Chicago, Northwestern and Fermilab are teaching some 'rich' offerings. Charles Hemann, UALR Planetarium, reports a twenty-four hour computer bulletin board (in cooperation with their local Astronomy Club) - call 501 569-3022 to see what's up. While in Boston Noreen Grice, Charles Hayden Planetarium, gave me information on their show THE H+ FACTOR - it tells about the travels of a proton from the time of the Big Bang! With a $4,000 grant the Planetarium's Service League has been working on tactile constellation maps on 11 x 11 paper in braille for the visually impaired. George Reed (West Chester/Spitz) reports Promstagus Books will be publishing Dark Sky Legacy this fall. It is about the impact of astronomy on culture. In Springfield (MA) Christine Roane, Seymour Planetarium, has a tremendously successful kindergarten presentation about nocturnal animals called NIGHT IS NICE (no wonder, even the title feels warm and fuzzy!). Progress is being made in the construction of the Space Quest Planetarium at the Children's Museum in Indianapolis. The planetarium hopes to open in the fall. Sharon Parker, director of the planetarium welcomes Wayne Blankebeckler, Daniel Hawkins and Gregory Barnes on board. Celestial navigation courses in land-locked Dallas? Richland College Cosmic Theatre offers a course reports Linda Irby! Director at Richland, William A. Dexter, reports a full schedule for summer classes, both night and day. Happy 25th Anniversary to the Elgin U-46 Planetarium! To celebrate this anniversary, and the 20th anniversary of the first lunar landing, the planetarium will be featuring special moon programs. S.W.A.P. members enjoyed Dr. Cyril Ponnamperuma's lecture "Experimental Studies on the Origin of Life" at their annual conference in San Angelo! Dr. Mark Sonntag, Angelo State Planetarium, was definitely the host-with-the-most! Looking for work - the Link Planetarium/Kopenik Observatory has established an eleven-month planetarium internship, beginning September 1, 1989. For more information, contact Bill Buckingham with Link at 30 Front Street, Binghamton, NY 13905. Congratulations to Great Lakes Planetarium Association - a 72% increase in membership since 1984!!

FACT OR FANTASY?
John Williams and Ron Dilullo of ASTRAL PROJECTIONS are finishing the first 13 episodes of science-fiction radio dramas for delivery to National Public Radio. This is for their SCI-FI RADIO project, which is funded by the Corporation for Public Broadcasting for 26 half-hour episodes. They should start airing this summer or early fall. The first batch includes FROST AND FIRE by Ray Bradbury and THE LAST QUESTION by Isaac Asimov. The series opener is I'M SCARED by Jack Finney and features the voice of David Kent, one of the original Orson Welles Mercury Players. He was in the original WAR OF THE WORLDS!

SCHOOL BOOKS, SCHOOL BOOKS
Eloise Koonce, Richardson I.S.D. Planetarium, has been advising the Texas State Board of Education (for the State of Texas Adoption Process) of the inaccuracies of astronomy information in the state's school books. Since the Textbook Committee adopts the textbooks for a six-year period Harold Van Schalk, Garland I.S.D. Planetarium, Jim Rusk, Mesquite Schools Planetarium, and Mary Kay Hemmingsway, University of Texas Astronomy Department, have been in on the input. The Textbook Committee has 'experts' in each area BUT not in astronomy! Kudos to this group for taking their time to help!

G.R.A.N.D.E.
Although not funded as of this writing, The University of Arkansas at Little Rock Physics and Astronomy Department, in co-operation with several universities, will be the onsite coordinators of the Gamma Ray and Neutrino Detector. It will be the largest neutrino detector in the world reports UALR Planetarium Director Paul Engle!

PSN CANCELS PLAN
The Planetarium Show Network, a consortium of major Canadian and American planetariums, has abandoned its proposed show.
REGIONAL ROUNDUP

Steven Mitch
Benedum National Science Theater
Oglebay Park
Wheeling, West Virginia 26003
(304) 242-3000 Ext. 261
CompuServe # 72467,2051

Any interesting news, events, activities, etc. from any of the IPS regions is greatly appreciated (the more, the better). If you have anything that you would like printed in the Regional Roundup column, please forward it to me at the above address or via CompuServe Easyplex.

The final deadline for submission into Regional Roundup for the next issue of The Planetarium is Wednesday July 5, 1989. Please mark your calendars accordingly.

Remember, you don’t have to be a regional newsletter editor to send “stuff” to me. If you have something interesting to offer, by all means, send it!

Thank you for you contributions and support!!

ASSOCIATION OF MEXICAN PLANETARIUMS (AMPAC)

AMPAC recently held their XIII national meeting at the Planetario “Nundehui” in Oaxaca, Mexico with Bernardo Somohano Ugalde, host. Fourteen planetariums were represented during the meeting. New AMPAC officers elected during the meeting were Alfonso Martinez, Vice President and Jorge Gabriel Pérez, Secretary. Alfonso Martinez is the Director of the Alfa Cultural Center in Monterrey and Jorge Gabriel Pérez is from the Mexican Astronomical Society. The 1990 AMPAC meeting will be held at the Merchant Maritime School Planetarium in Tampico, Mexico, in January.

AMPAC member planetariums will cooperate and provide advice to government agencies in charge of coordinating the July 11, 1991 total solar eclipse observations.

A commission for evaluating educational planetarium programs was established. The purpose of the commission is to give advice concerning veracity of astronomical facts and data presented in programs.

Martha Cortinas has recently been appointed as Educational Coordinator of Planetarium Programs at the Alfa Cultural Center, Monterrey, Nuevo León, Mexico.

The meeting also included visits to the archaeological sites of Monte Alban and Mitla where native astronomers observed the universe hundreds of years ago.

BRITISH ASSOCIATION OF PLANETARIUMS (BAP)

On March 11, 1989 the British Association of Planetariums met at the Jodrell Bank Science Center in Cheshire. E. M. Morrison gave the latest information in writing software for science exhibits. The meeting next year will be in Tyne & Wear at the South Tyneside College Planetarium. Kudos to the United Kingdom facilities for paying I.P.S. dues for the Eastern bloc of planetaria—U.K. is looking forward to the swapping of ideas with the group!

EUROPEAN ASSOCIATION OF PLANETARIUMS (EMPA)

No report; Dennis Simopoulos, representative

GREAT LAKES PLANETARIUM ASSOCIATION (GLPA)

The 25th Annual Conference of the Great Lakes Planetarium Association will be held October 18-21, 1989 at Parkland College in Champaign, Illinois. Conference highlights will include a 3-video projector demonstration by the University of Illinois’ National Supercomputer Center, a review of the year’s astronomical highlights by Dr. James Kaler of the University of Illinois, and highlights of Voyager II’s encounter with Neptune from JPL. For more information contact: Mr. David Linton, William M. Staerkel Planetarium, Parkland College, 2400 West Bradley Avenue, Champaign, Illinois, (217) 351-2568.

A special thanks from GLPA is extended to Dale Smith of the Bowling Green University Planetarium for his expediency in getting the 1988 conference proceedings to all GLPA members.

The Elgin U-46 Planetarium celebrates its 25th Anniversary this year. To commemorate the anniversary, and the 20th anniversary of the first lunar landing, the planetarium will be working with the Elgin Public Museum to develop special moon programs and display a moon rock. In December, the
600,000th student passed through the doors of the planetarium. Finally, the planetarium’s Spitz A3-P has been completely refurbished and upgraded. Congratulations to the folks at Elgin!

Garry Beckstrom has left the Ruthven Planetarium in Ann Arbor to accept a position as staff lecturer and production assistant at the Longway Planetarium in Flint, Michigan. Matt Linke has accepted the position as planetarium coordinator for the Ruthven Planetarium.

Due to overwhelming requests, the Astronomical League’s Astronomy Day Handbook supply (150 books) has been completely exhausted. Currently, sources for funding a slightly modified second edition are being explored. If anybody can assist with funding or printing, or has any idea or suggestions, please contact Gary Tomlinson at the Roger Chaffee Planetarium in Grand Rapids, Michigan.

Jeanne Bishop is currently working on a photo album for the 1989 GLPA Conference in Bowling Green. She would appreciate receiving photographs of the conference from members. Please send them to: Jeanne Bishop, Westlake Public Schools Planetarium, 24525 Hilliard Road, Westlake, Ohio 44145.

GREAT PLAINS PLANETARIUM ASSOCIATION (GPPA)

No Report; Alinda Wengenroth, representative

MIDDLE ATLANTIC PLANETARIUM SOCIETY (MAPS)

MAPS held their annual conference April 6-8, 1989. The conference was co-hosted by the New Jersey State Museum Planetarium, Trenton, New Jersey, and the Central Bucks East High School Planetarium, Buckingham, Pennsylvania; co-hosts were Dick Peery and Tom Stec. Conference highlights included the usual fine assortment of papers, workshops, panel discussions and “Taurus Incidents.” Dr. Jerry Mallon, Methacton School District Planetarium, gave a paper on “Project E. T.; A status Report” which centered on activities and plans for his Challenger Center grant project. Noreen Grice, Charles Hayden Planetarium (Boston), gave a paper entitled “Astronomy for the Visually Impaired,” which was well received. George LoVoi, Hayden Planetarium (New York) gave a paper and planetarium demonstration entitled “A Parade of Pole Stars,” a discussion of past, present and future south polar stars using precession. Fred Stutz talked about the opening of a Challenger Center at the Howard B. Owens Science Center this fall. The I.P.S. award-winning program, “2061: Halley Rendezvous” was shown as well as “The Power,” from the Bishop Planetarium, Bradenton, Florida. Audio-Visual Imagineering performed another of their great public LASER shows called “Laser Magic.” The Margaret Nobel Address was presented by Laurence Marschall, Gettysburg College and was entitled “The Supernova Story.”

The 25th Annual MAPS Conference is scheduled for May 2-5, 1990 at the Benedum National Science Theater, Oglebay Park, Wheeling, West Virginia. The conference host will be Steven Mitch.

Congratulations are in order for two MAPS representatives who were the recent recipients of grants to attend the Astronomy and Space Science Summer Institutes in Berkeley, California, conducted by the Lawrence Hall of Science and the New York Hall of Science. They are Tom Stec of the Central Bucks High School Planetarium and Terry Buchalter of the Northeast Bronx Planetarium.

The Link Planetarium/Kopernik Observatory has established an 11-month planetarium internship, beginning September 1, 1989. A Bachelors of Science or Education degree is required, along with some planetarium or museum experience. For more information contact: Bill Buckingham, Link Planetarium, 30 Front Street, Binghamton, New York 13905.

The Strasenburgh Planetarium is currently accepting applications for the position of Planetarium Intern. This marks the 19th year that the Strasen­burgh Planetarium has offered the internship program to interested students. Requirements include a B.A. or B.S. degree, some planetarium experience, and a comprehensive knowledge of contemporary astronomy. For additional information about the internship program contact: Francis Biddy, Producer/ Astronomer, Strasenburgh Planetarium of the RMSC, Box 1480, Rochester, New York 14603, (716) 271-4320.

The new Spitz 512 computer automation system is in its final stages of development and is about to go into production. The new system will run on a personal computer with a Winchester hard drive allowing for on-line and off-line programming of all instrument functions, special-effects projectors, slide projectors, video projectors and room lighting. Preliminary specifications are available upon request from Spitz.

NORDIC PLANETARIUM NETWORK (NPN)

Construction work is well under way at the Heureka Science Center outside Helsinki, Finland. The outer dome of the 18 meter diameter Verne Theater Planetarium was completed in mid-March. The facility will be equipped with a Zeiss-Jena star instrument and a 70mm, 8 perf, hemispheric film projection system. Construction started in February at the world’s northernmost planetarium, the 12 meter diameter Northern Lights Planetarium is Tromsø, Norway. Its latitude is 69.6 degrees north! The planetarium will be equipped with a Spitz 512 instrument and a Cinema-360 film projection system.

The building of an Omnimax Theater is Stockholm, Sweden finally got the go-ahead last December. It will be connected to the Swedish Museum of Natural
History, which is currently undergoing major renovations.

Tytti Sutela has been appointed Planetarium Director of the Verne Theater in Helsinki, Finland. Erling Husby and Frank Pettersen will share joint responsibilities for the Northern Lights Planetarium in Tromsø, Norway.

Tromsø officials announced that they will be hosting the 1990 Cinema-360 Conference immediately prior to the 1990 IPS Conference in Borlange, Sweden.

The next NPN meeting is planned to be in Tromsø, August 25-26, 1989.

PACIFIC PLANETARIUM ASSOCIATION (PPA)

No report; Larry Toy, representative

PLANETARIUM ASSOCIATION OF CANADA (PAC)

The Planetarium Association of Canada cordially invites IPS members and affiliate members to participate in their 1989 Conference to be held in Montréal, Québec, June 27-30. The host institution for the conference will be the Dow Planetarium and the conference theme is: Classrooms Under the Dome (school shows, activities, and more ...). (It was at the Dow in 1967 that the directors of most of the Canadian planetaria met to establish the Planetarium Association of Canada. The 1989 Conference will be the first time the Association has met in Montréal since the Association was founded!) Guest speakers for the conference include: Dr. E. C. Krupp, Director of the Griffith Observatory; Dr. René Racine, Université de Montréal and Director of the Observatoire du Mont-Mégantic; and Dr. Jean-René Roy, Astronomer, Université Laval. For additional information about the scientific program or to receive a complete registration package and accommodation information, please contact: Mrs. Nicole Patenaude, Planétarium Dow, 1000, rue Saint-Jacques ouest, Montréal, Québec, Canada, H3C 1G7, Tel.: (514) 872-4530, Fax: (514) 872-8102.

Two astronomical exhibitions of photographs, models and interactive displays are being shown at the Ontario Science Centre, Toronto.

Michael West of the Saskatchewan Science Centre in Regina reports that a gigantic Big Bang exhibit is being assembled. Three stories high with gigantic murals of galaxies and nebulae, it will be like "walking into a large kaleidoscope."

The Alberta Science Centre and Centennial Planetarium are currently engaged in building and fund raising for the Hall of Science and Specialty Thea-
tre. Katherine Sammons has joined the staff as Chief Interpreter.

The show of the H. R. MacMillan Planetarium, Vancouver, titled “Interstellar Suite,” featured no narration and celebrated the 20th birthday of the planetarium.

**ROCKY MOUNTAIN PLANETARIUM ASSOCIATION (RMPA)**

Carolyn Petersen sent along an interesting tidbit of information concerning one of our former European planetarians. Gerhardt Rohner, formerly of the Hamburg Planetarium, is now heading a firm called Galaxy Art. Galaxy Art produces and presents planetarium programs, etc. and are planning a planetarium show festival next year. Prizes will go to the person who has brought new ideas and activities to the European Planetarium community. The award will be called the Arthur Barton Memorial Award.

The Petersens are currently working on their usual fine assortment of music and programs for planetariums. They are eagerly awaiting the upcoming Voyager encounter with Neptune, with all the new information going into their next production scheduled for release later this year.

**SOUTHEASTERN PLANETARIUM ASSOCIATION (SEPA)**

The Southeast Association of Planetariums will hold its Annual Conference in Lafayette, Louisiana, from June 28 through July 3, 1989. The schedule includes visits to planetariums in St. Martinsville and New Orleans, Louisiana, and a trip to Stennis Space Center in Mississippi. The last two nights of the conference will be spent in the New Orleans French Quarter. The banquet speaker will be Dr. Matt Siebel, former Director of the Michoud Assembly Center. For more information about the upcoming conference, contact: Dave Hostetter, Conference Host, Lafayette Natural History Museum and Planetarium, 637 Girard Park Drive, Lafayette, Louisiana 70503, (318) 268-5544.

The SEPA script bank is currently being handled by Lee Golden, who may be contacted at 1098 Beckman Drive, Daytona Beach, Florida 23019.

**SOUTHWEST ASSOCIATION OF PLANETARIUMS (SWAP)**

The 1989 SWAP conference was held April 8-10 in San Angelo, Texas. The host for the conference was Dr. Mark Sonntag of the Angelo State University Planetarium. Guest speakers included Mr. J. A. Jaquier, from the Regional Steward Office of the State Archaeologist; Dr. Chris Sneden, Project Scientist, University of Texas Spectroscopic Survey Telescope; and Dr. Cyril Ponnamperuma, Director of the Laboratory of Chemical Evolution and Professor of Chemistry at the University of Maryland. Mr. Jaquier's talk was entitled “Prehistoric Indians of the Concho Valley.” Dr. Sneden's talk detailed the latest information on the University of Texas at Austin and Penn State University's joint project—the Spectroscopic Survey Telescope. Dr. Ponnamperuma's lecture was entitled “Experimental Studies on the Origin of Life.” Other conference highlights included a trip to the Fort Concho National Historical Site, a West Texas Barbecue, a planetarium Show-S-THON, a Star Party at the Spiller Ranch and Observatory.

During the annual SWAP Awards Banquet, Barbara Baber, Morgan Jones Planetarium, was the recipient of The H. Rich Calvird Award for outstanding professionalism and service to the planetarium field. Congratulations Barbara! Bow Walker, Hudnall Planetarium, was the recipient of the dubious Bend Cage Award for the distinction of having the worst disaster in a planetarium (fire).

Officers continuing in their second year of service to SWAP are: Wayne Wyrick, President; Mark Sonntag, Vice President; Harold Van Schaik, Secretary/Treasurer; Donna Pierce, IPS representative. Steven Zavalney, Don Harrington Discovery Center Planetarium, was appointed to the SWAP Board. The new editor of the SWAP Newsletter is Charles Hemann of the University of Arkansas Little Rock Planetarium. Jim Rusk resigned as the editor, effective at the close of the conference. Two new committees were approved during the conference: Conference Planning Committee and a Membership Committee.

The 1990 Annual SWAP Conference will be held at the Hudnall Planetarium in Tyler, Texas with Bow Walker serving as conference host. The 1991 conference will be held at the Discovery Center in Amarillo, Texas with Steven Zavalney serving as conference host.

SWAP welcomes a new planetarium member into their ranks. He is George Owen, New Director of the Beaumont Independent School Planetarium in Beaumont, Texas.

The McDonald Observatory will celebrate its 50th Anniversary, with Frontiers of Stellar Evolution, July 24 and July 28, 1989. Day activities will be at Sul Ross College in Alpine, Texas, with visits to the Visitor's Center and the Observatory on Mount Locke in the evenings. Topics are: Stellar Evolution-Then and Now; Formation of Stars; Evolution of Single Stars; Deaths and Transfiguration; Interacting Binary Stars; Applications to Galactic Evolution; Future Prospects and Summary. Featured astronomers include: N. J. Evans II, R. Kudritzki, J. Liebert, B. Gustafsson, J. Hesser, P. R. Wood, D. L. Lambert, G. Knapp, H. Van Horn, W. D. Arnett, I. Iben, Jr., D. N. Lin, B. Warner, J. Craig Wheeler, R. Larson, C. Sneden and Harlan J. Smith. For more information, contact: McDonald Observatory, The University of Texas at Austin, MLN 15.308, Austin, Texas 78712-1083.

_The Planitarian_, Vol. 18, No. 2, June 1989
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We look forward to hearing from you and the possibility of working with you.
President's Message

Terence Murtagh
Planetarium Armagh
College Hill, Armagh
Northern Ireland, United Kingdom

Well hello from Ireland. Hopefully the editor will retain my European spelling, so keep your children's eyes averted from such words as colour or programme. You have been warned! I realise that I am, so far, the most distant President from the majority of I.P.S. members, physically that is, therefore I want to let you know that I am easily contactible through the Planetarium, though as I tend to travel quite a bit, for a quick response please phone or fax. Remember that Northern Ireland is part of the United Kingdom and is therefore Country Code 44 which is different from the code for Ireland which many overseas operators whose geography is not too good are prone to overlook. My phone number at the Planetarium is 861 524725 and the Planetarium secretary Eamon Rafferty will be pleased to ensure that all messages and enquiries reach me promptly. Our fax number is 861 525187. So feel free to call.

I would like to send congratulations to President-Elect John Pogue and to Gerald Mallon and Mark Petersen. My commiserations to the losers in the election and thanks for their participation in an important part of I.P.S. activities. All members should feel that they can and should participate in our work and I'm glad to see that some of the initiatives which were started at last year's conference are coming along so well.

As I write this in Armagh I'm waiting the arrival of Bill Gutsch, the Director of the Hayden Planetarium in New York. He's over having a look at our interactive system, where the audience control the content of the show, and to continue cooperative work on a rather interesting project which I hope he will be able to say more about later in the year. Incidentally about our interactive video work—I have written a paper which I have sent to the editor with this message so I hope it

I. P. S. President Terence Murtagh: I thought you might like to see what your president looks like.

62 The Planetarian, Vol. 18, No. 2, June 1989
may be published in *The Planetarian* in the not too distant future [see page 20]. Bill is an amazing character—an intellectual whirlwind who not only has lots of good ideas but actually makes them work. People are always asking him how he does it and he always answers the same—"by getting off my butt and doing something about it". Often we planetarians are very good at doing something about it. In reality most of us are extremely lucky to work in a profession which we love but to which we contribute very little in terms of ideas or progress. So let's get to work.

Talking of progress, this is a very exciting time for planetaria in Europe. There are a number of new planetaria coming on stream, and new blood at some of the older establishments is bringing more exciting programming to many more people. Remember it's not too long ago since the majority of European planetaria presented shows with little or no effects content and where the projector was the source of all interest, or none if you were a member of the audience. In Paris I visited just such a place in 1988 and it was terrible. It was not I hasten to add at La Villette. In the last year I have had the opportunity to visit a number of interesting places and I hope to tell you about them in more detail over my next series of messages. First I'm going to begin with a quick visit to the Planetarium in Tampere, Finland which I hope many of you will visit next year.

I was there last spring helping with the production of their first video presentation and was much impressed by the whole operation. I had met the Director, Timo Rahunen, at the International Planetarium Directors Conference in Moscow and we got to talking about the use of video projection. He was looking for a way to upgrade an existing old planetarium with very few effects and put more "pizzazz" into production. Having visited Armagh and done some independent research, Timo decided that video was the way to go and so installed four Sony projectors, a number of 3/4" SP-UMatic players, together with a small edit suite and got down to business. The result has been great success all round with good audience reaction and attendance. The Tampere Planetarium is twenty years old, it has a Minolta projector, 13 metre dome and seats 112. The planetarium is a commercial operation and is owned by the Sarkanniemi Company. It is situated below the giant revolving tower restaurant which is at the heart of a huge theme park run by Sarkanniemi on the shore of one of Tampere's many lakes. Timo is a former professional astronomer who specialised in stellar evolution before becoming a planetarian about four years ago. That decision alone shows what a sensible person he is. Not only is he responsible for the operation of the Planetarium, but a beautiful aquarium and dolphinarium as well, so John Hare better keep an eye on his "mermaid". (The Bishop Planetarium and Museum in Bradenton, Florida, has a manatee). Timo

*The Minolta projector in Tampere and the four Sony video projectors installed last year.*
tells me that he hopes to have an interactive system in operation in his theater by this autumn (Northern Hemisphere) and is planning a video workshop to coincide with our IPS visit to Sweden and Finland in July 1990. Tampere is a short hop from Helsinki and will be a really worthwhile visit for I can thoroughly recommend not only the well managed Planetarium, but also the wonderful hospitality, interesting saunas, and delicious reindeer steaks of which I have very fond memories.

All of us in Europe hope that as many of you as possible will make the effort and support the IPS Conference in Borlange in 1990. Now is the time to start saving. You can be assured of a warm welcome from all your European colleagues.

Recently I was very sorry to learn that the Digistar Users Group had decided not to make their Digistar generated material available to non-Digistar users. Now, I can appreciate their desire to maintain the uniqueness of a Digistar presentation, and not provide images which would in effect almost put them at a disadvantage. However I hope that they might rethink this policy in that they might allow small segments of specific Digistar effects to be made available on a commercial basis. This would be more in keeping with the general co-operative trends within the international planetarium community and would avoid the over-exploitation of Digistar material, which is what they wish to prevent. I would certainly agree that anyone who wishes to simply record a complete or partial Digistar show should try to buy a Digistar. There are however, some very interesting Digistar effects which could be made generally available without destroying the unique experience of a full Digistar presentation and at a cost which would let smaller or less well off planetaria enhance their presentations. Which is of course, good for us all. Please think again chaps.

That's all for now next time I hope to tell of interesting developments down under and the new Planetarium in Amsterdam which is set in the Zoo. Seems appropriate doesn't it!

The Tampere Planetarium is at the base of Scandinavia's tallest tower and revolving restaurant. The views are excellent and the food is even better.
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If *planetarian* is the name we give to ourselves as persons involved in PLANETARIUMISM, then a perverted subgroup of planetarians who perpetuate sniglets must be "sniggers." I had thought that sniggers were currently in their dormant or larval resting stage, but NO! Poking their heads up through layers of discarded planetarium scripts, they have announced their reawakening.

Jon Bell, Planetarian at the Living Museum in Newport News, Virginia is credited in previous columns. "A sniglet," says Jon, "is a word or phrase that isn't in the dictionary, but should be." For example, Jon's" Schiaparelli-Lowell Syndrome (AKA the Gribben-Plagemane Contagion) —a debilitating malady that affects astronomers who suddenly and without warning lend their names and reputations to theories about faces and pyramids on Mars, planetary alignments, and Elvis sightings.

Uh, oh. Another snigger retaliates. Planetarian John Pogue of Grand Prairie Planetarium in Texas adds these sniglets:

*chronolumenosis*—the seemingly uncontrollable urge that overcomes some youngsters to light up their LCD watch dials and wave them about menacingly during periods of extreme darkness in the planetarium.

*chronosuzak*—those annoying little electronic tunes that emanate from young planetarium audiences, some of whose members are proud owners of modern electronic watches. Particularly frequent right after Christmas.

*Doo-dee-doo Complex*—condition that some planetarium spectators possess whereby they feel compelled to mimic the "Twilight Zone" theme music as the planetarium darkens.

*Gripper-ripper*—that young planetarium visitor who, under wrap of planetarium darkness, is either repeatedly securing and separating his velcro clothing fasteners or is ripping your upholstery to shreds.

*Meteorophones*—the arcade-laser type sound effects added by young planetarium spectators to projected meteors, especially during a meteor shower. Variations also exist in the form of "cometophones," "asteroidophones," and "pointerophones."

* Orreryicide*—what happens to PR-12 bulbs in a Spitz 512 orrey projector.

*Pavlovistrator*—elementary school principal conditioned to the extent that he must immediately fill with students any yellow bus that arrives at his school; i.e., if the bus arrives an hour early, YOU get'em an hour early (probably during your lunch).

*Pedagogihistrionics*—the preparatory action of some teachers whereby they provide or coach their students to have (sometimes written) questions to ask the planetarium instructor, thus ensuring that their students' inquiries will be more profound and impressive than the other classes' spontaneous ones.

*Neotonarcolepsy*—state of those planetarium visitors who are able to reach REM sleep before the planetarium lights are dimmed. Ed. note: This must occur in fellow snigger Jon Bell's "snorezone-section of planetarium in which familiar noises emanate in the dark."

*Pseudonarcolepsy*—the attention-getting act of some elementary students who feign being asleep when time for their group to leave the planetarium. This condition is easily detectable as this is the same kid who wiggled, squirmed, and made disgusting body noises during the entire program until the lights came up!

Whew! These sniggers are INTO their thing! Jon Bell's comment about John Pogue's sniglets; "Here's a man who gives a lot of planetarium shows!" To make the record clear, Jon reminds us that Ken Wilson (Planetarian from the Universe Space Theater in Richmond, Virginia)'s "Green Flash-a Martian who streaks your dome" is NOT a sniglet; it's a daffynition, because "green flash" already exists with another meaning.

So if you're thinking of joining the sniggers, keep that in mind. I only got through the "P"s with John Pogue's sniglets ... more later. Let me hear from you; sniggle away!
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