SOUTHERN SKIES

AUTUMN 1991 - WINTER 1992

Journal of the Southeastern Planetarium Association

Southeastern Planetarium Association Officers for 1991-1992

President: Robert Tate, Harper Planetarium

President Elect: Richard McColman, Gibbes Planetarium

Past President: Dave Hostetter, Lafayette Planetarium

Secretary-Treasurer: Linda Hare

Editor, *Southern Skies*: Kathy Summers

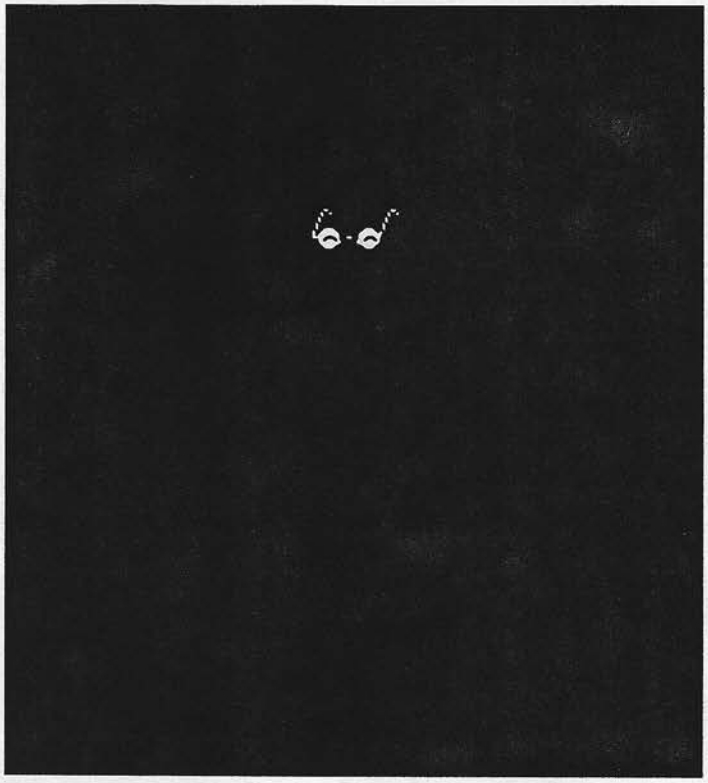
Historian: Jane G. Hastings

Send contributions to *Southern Skies* to:

Kathy Summers
661 Paden Mill Trail
Lawrenceville, GA 30244
(404) 995-1263 - evening
(404) 727-6334 - daytime

A Message From The President

Bob Tate
Harper Planetarium
Atlanta, GA



Bob Tate in his planetarium wearing his new day-glo glasses.

Once again the school year is half over. It has been a busy one already for us here in Atlanta. At our Northside Planetarium renovations have been underway to separate the facility's heating and electrical system from the rest of the high school building's systems. This is in preparation for extensive renovations to be made to the high school during which it will be closed for about three years. Fortunately the board of education recognized the need to keep the planetarium in full operation during the school's renovation. While work was going on in the planetarium, asbestos was removed and the Spitz A4-RPY projector was rewired to run on the computer-control system developed by the folks at Brevard Community College Planetarium. This completes the conversion of all three of our planetariums to computer control, a goal we been pursuing for several years.

Another important event for us was the announcement of new goals for the year 2000 for our school system. For the first time in the nearly twenty years I have been with the school system, administrators are paying attention to science education. For the first time, improving our system's standing in science, math, and technology are getting the attention we science educators think it deserves. This, I am sure, is a result of the attention science education has received by President Bush at the national level. A committee is already hard at work to implement changes which will allow us to meet our new science goal, and all three of our planetarium coordinators are working on this committee. Hopefully our contributions will be of value.

On a sadder note, longtime planetarium director of the planetarium at the St. Martin Parish Science Center, Isadore Inman, Jr., died of a heart attack just before the Atlanta SEPA Conference. Isadore had made a practice of attending our conferences during the past few years, so we were surprised to find him missing from the conference. I always enjoyed talking with him about what was going on in his small planetarium out in Cajun country. Isadore wore many hats in his position, working both with students and teachers to improve science education in his county and running, not only the planetarium, but also the science center. Those of you fortunate enough to attend the SEPA conference in Louisiana in 1989 will remember visiting Isadore's planetarium. We will miss him.

For those of you who missed the SEPA conference, an amendment to the constitution changed our membership year. Formerly, our membership year ran from conference to conference creating some confusion as to when dues were due, particularly in years when the conference was later than normal. We will now have memberships run on a calendar year. We will still collect dues at the conference for those who wish to turn theirs in, but those dues will be for the next calendar year.

A CALL FOR A NATIONAL PLANETARIUM ORGANIZATION

by Robert Tate
Harper Planetarium
Atlanta, Georgia

From time to time at various planetarium conferences small groups of planetarians, usually located in the hospitality suite, have been known to discuss the need for a national planetarium organization. More formal plans have even been circulated among interested parties, but nothing has ever come of these discussions. For various reasons, a couple of which I will detail below, I believe the time is right to seriously consider the formation of a body to represent the planetariums of the United States of America.

Now why would anyone want to add another level of organization to what already exists? After all, we have our regional societies which meet regularly, and we have the International Planetarium Society, which meets every two years, and keeps us informed with the *Planetarian*. It seems that adding another organization would just dilute our current efforts and create ill feelings by competing for membership dollars. Shouldn't we just leave well enough alone?

* * * * * * * * *

. . .the future of planetarium education in this country depends on our aggressive efforts to expand the number of planetariums in this country, and to improve the quality of our programs.

* * * * * * * * *

Several recent developments have shaken my complacency, and I now am convinced that the future of planetarium education in this country depends on our aggressive efforts to expand the number of planetariums in this country, and to improve the quality of our programs. The first development deals with our national initiative in science education. President Bush, in reaction to a number of studies which have recently pointed out deficiencies in the U. S.'s science education, has developed goals designed to place our nation in a leading role in science educating. But no where in any of the literature or discussions, have I seen any indication that either the President or any of his advisors have given thought to the importance of planetariums in this national endeavor. We know the educational value of the planetarium to our students, but with fewer than one thousand active planetariums in the entire nation, only a small percentage of our students ever visit a planetarium. Part of the national effort to educate our youth in science should include the installation of more planetariums and the improvement of the educational offerings of new and existing planetariums. We need an organization to point this out to the President and his policy makers.

* * * * * * * * *

The decision to close the planetarium as a money-saving move is a real threat to our institutions.

* * * * * * * * *

A second vital concern deals with the economy. The vast majority of planetariums in our nation were built with National Defense Education funds in response to the Soviet launch of the first man-made satellite. I have often said that most of us owe our jobs to the Spitz salesmen who were smart enough to show local school administrators how they could build a planetarium at government expense. The result of this national initiative was the construction of many planetariums. Since the sixties, many planetariums have thrived, but some have closed or have fallen into disuse. Some, which have been in daily use, are now aging, and serious decisions will have to be made concerning renovation or replacement. In many cases, the renovation costs can be orders of magnitude greater than the initial installation costs. Administrators often find it difficult, in light of current economic stress, to spend the money needed to renovate an old planetarium. The decision to close the planetarium as a money-saving move is a real threat to our institutions. Again, the need for aid to existing planetariums points out the importance of a national organization.

So reasons exist for a national, unified movement to promote and upgrade planetariums. But can't this movement be carried on by the existing planetarium societies? The answer is, unfortunately, no.

The existing regional societies do a good job of keeping communication channels open in the regions, but there is little communication among the regional groups except through the International Planetarium Society, and there are no programs to promote cooperation toward meeting common goals.

One might assume that I.P.S. should bear the burden of acting as our national organization. The fact of the matter is that I. P. S. will not, and can not act as our national organization. I. P. S. is truly an international organization, by design and in function. It is composed of a number of regional and national societies from all around the world. Its stated goal is to open channels of communication among planetariums everywhere. Its purpose is not to promote planetariums in any one country, or to represent the planetariums of any country in discussions with governmental organizations. Back when Jim Hooks was president of I.P.S. (then known as the International Society of Planetarium Educators) he attempted to make contact with groups in our federal government who might have an interest in working with planetariums toward mutual goals. It was explained to Jim in no uncertain terms that our governmental organizations had no interest in, and were prohibited from dealing with, "international organizations". If we are to work with those in our own government who can help us, and whose efforts we can support, it must be done by an organization which is of our own nation's making!

How are we to crank up another professional society without spreading our resources of funds and personnel to the breaking point. The answer lies in organization. We currently have the mechanism to economically create our national planetarium society by making use of the existing regional societies. My plan is not to create an entirely new organization, but rather to create an add-on coordinating group, the National Planetarium Council, whose leadership committee would be made up of representatives from the existing regional organizations. The purpose of this Council would be to coordinate efforts of the existing planetarium societies and act as an official body which could deal with governmental agencies. Anyone holding membership in one of our regional societies would automatically become a member of the national organization. Bylaws would specify that the members of the leadership committee would also be the regional I. P. S. representatives. Officers for the new council would be selected from among those regional representatives. The reason for this connection with I. P. S. is two-fold. First, since the I. P. S. council meets annually, it would be desirable to have our National Planetarium Council leadership committee schedule its meeting concurrently. The second reason for the I. P. S. connection is to keep members current on vital affairs. While this would make for double duty for our council representatives, it would be the easiest, most cost-effective means of developing our national planetarium representative organization.

* * * * * * * * *

The goal here is to produce an organization to represent all the nation's planetariums to all other organizations within our country who have interests and goals in common with ours.

* * * * * * * * *

Added benefits to this method of organization would be the close relationship which would naturally develop between the new National Planetarium Council and the existing planetarium societies. We're all the same people anyway! The goal here is to produce an organization to represent all the nation's planetariums to all other organizations within our country who have interests and goals in common with ours. This might include the Department of Education, the National Science Foundation, the National Endowment for the Humanities, the National Endowment for the Arts, N.A.S.A. and any number of nongovernmental organizations.

Since existing communications channels exist, funding needs would be kept to a minimum by not having to publish a journal. Any other funding would come from the regional societies which, believe it or not, can afford it!

The formation of a national organization is overdue. With a little coordinated effort we could make it a reality. To make such an organization a reality requires an *ad hoc* committee to produce bylaws which can be adopted by each of the regional societies. The benefits to society of promoting our planetariums dictate that we make an effort to organize such a society.

SONG OF THE STARS

by Von Del Chamberlain
Hansen Planetarium

Introduction

Probably no story of the sky, at least one coming from traditions of North America, is more widely known than the Algonquin story about hunters chasing a bear. It has been used in many planetarium shows and is found in Boy Scout books and many other publications. Let us briefly review key elements of the story.

The four stars of the Dipper represent a bear which comes out of hibernation each spring and moves upward through the evening sky.

Three hunters stalk the bear: the first carries a bow and arrow, ready to shoot. The second carries a pot to cook the bear in. The third collects fuel for cooking the bear.

All summer long they pursue the great animal.

By autumn, the bear's strength fails and the lead hunter wounds it. Blood falls from the sky, tinting the leaves of maple, sycamore and other trees.

With the chill of winter, the bear dies and the year, too, comes to an end. But the creature's soul cannot die; it enters a new body and rests through the long, cold winter.

By spring it has new strength and, along with other signs of new life, appears again, rising into the evening northeastern sky.

Year after year the hunters follow the bear as both Earth and sky repeat the seasonal sequence, while people below tend to repeat their activities as part of the great cosmic, cyclic design.

This is a story we are all familiar with. It involves cycles of nature--cycles related to what we see in the sky. It is, then, a way to account for relationships between changes in the sky, the Earth and how these are related to things of substance to humans. This is an interpretation of something we notice in the sky--something that has always been noted by people, yet explained in many different ways.

This story is just one example of the many phenomena of the sky that have been interpreted differently by people in different places, at different times with different survival and well-being concerns. I chose to begin with this particular story for another reason as well. It is part of my all-time favorite poem about the sky: an Algonquin song of the stars.

Song of the Stars

We are the stars which sing,
We sing with our light;
We are the birds of fire,
We fly over the sky.
Our light is a voice.

We make a road for spirits,
For the spirits to pass over.
Among us are three hunters
Who chase a bear;
There never was a time
When they were not hunting.

We look down on the mountains.
This is the song of the stars.

--Algonquin Indians

What I enjoy so much about this poem is the fact that it can be applied over and over again. It can be applied to many different people. It can be interpreted in different ways. It certainly can be interpreted in the modern scientific way. As a poetic statement, it is appropriate to describe what astronomers, the harvesters of starlight, do. Indeed, all people, in their own times and places, with their own cultural sensitivities and values and with their frames of knowledge, could be said to listen to the song of the stars, attempting to hear and understand the words and phrases. Today's astronomers have been able to get more detail out of the syllables composing the song than ever before. The song goes on . . . and on . . . and on. The meanings change, but the words do not need to change.

Planetarians Sing the Song of the Stars

How does this wonderful song apply to us? Without singers, a song has few listeners--few who learn the tune and the words--few who repeat the song. We are the singers of the Song of the Stars. It is our profession. It is what we do. We are the first people in history, as far as I am aware, whose profession it is to sing the Song of the Stars. We sing it using many forms of accompaniment. Our mission is clear: we are to understand the song and to artistically and effectively sing it for the benefit of people. It is our work to interpret the Song of the Stars in its many dialects, its many versions, its multiple verses, sung to different tunes.

Thus, we present programs about mythology of the sky. We present programs about the history of development of concepts and discovery of knowledge about the sky. We present programs about space exploration--about the growing knowledge of planets in the Solar System. We present programs that raise deep questions about origins of things, about whether or not we are alone, about how things are changing and about the destiny of things. We present programs about Earth, Moon, Sun, planets, stars, nebulae, galaxies--about this grand conception called the universe. In order to understand such things we present programs about molecules, atoms, nucleons, and about the fundamental forces of the universe.

You have probably heard that someone once said that a human being is an atom's way of knowing about atoms; a human being is a star's way of knowing stars; a human being is the universe's way of contemplating itself. In this same way of thinking, we could say that a planetarian is a star's interpretation of its own light, its "voice."

We are teachers and interpreters. We are singers of the Song of the Stars. Our instruments and devices project light. "OUR LIGHT IS A VOICE." "WE SING WITH OUR LIGHT."

It is true that some others have had this as part of what they do. Ancient philosophers and modern astronomers teach about and interpret astronomy. Public school teachers teach astronomy. Astrologers even sometimes teach a limited astronomy in limited and distorted ways. But it is our profession to interpret astronomy--to sing the song of the stars. First and foremost, it is what we do.

This brings to mind a few quotations. I collect selected quotations about the sky. As you read them, please think about what they mean to planetarians, whose duty it is to sing the song of the stars. Please consider what these words tell us about our work.

> Astronomy is useful because it raises us above ourselves; it is useful because it is grand;...it shows us how small is man's body, how great his mind. His intelligence can embrace the whole of this dazzling immensity, in which his body is only an obscure point, and enjoy its silent harmony. Thus we attain self-insight, something which cannot cost too dear, since this insight makes us great.
>
> --Henri Poincare

> Astronomy--the noblest proof of the human mind.
>
> --Laplace

> It is a feeble light that comes to us from the stars, but without it what would be the present condition of Man'sd mind?
>
> --Jean Perrin

And finally:

> The scientist does not study Nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if Nature were not worth knowing, life would not be worth living.
>
> --Henri Poincare

This also brings to mind a story. It is a true sory that has had a major influence in my life. It was written years ago in the American Journal of Physics, by a physics professor who taught physics to non-science students. Through years of doing this, he noticed that there were two extreme types of students who graduated from his university. One group expressed confusion over four years of learning, and might be heard to say, "the

scientist looks at things one way, the sociologist another and philosophers throw everything into question. I am really confused." At the other end of the spectrum was the student that might summarize college experience by saying, "I feel like I am just beginning to learn about a wonderful world that I am part of. Science has helped me know both about myself and the world. Social studies help me know my fellows, and philosophy helps me see the context of life with the entire human experience. I want to go out of college and continue learning."

The physics professor wanted to help students learn to sit back and put their studies in context with their lives. He considered various things he might do to cause this to happen. One of the ideas he decided to try was to invite some of his colleagues to address his students on the relationships between their disciplines and that of physics. At the beginning of one semester, he invited a biologist, a psychologist and a philosopher to take the first three class periods.

On the first day, the biologist stood before the new class and started the lecture by saying, "biology is the study of Man and his environment." then went on to explore the importance of applying physics to biology. On the second day, the psychologist introduced his lecture with, "psychology is the study of Man in his environment." It was no surprise to the students to hear the philosopher, on the third day, say, "philosophy is the study of Man in his environment," then explore the boundaries of physics and philosophy.

This was exactly what the physics teacher had hoped for. He stepped before his new students on the fourth day and said with gusto, "physics is the study of Man in his environment." He spent the rest of the semester proving that statement.

Coming back now to the planetarian, we attempt to make sky phenomena significant, enjoyable and understandable in the lives of people--to make astronomy the "study of man in his environment." Sky interpretation IS the "study of man in his environment. We sing about this using our projectors--"OUR LIGHT IS A VOICE." Like birds of fire, "WE FLY OVER THE SKY."

Our Subject Matter

The next point I want to make concerns our subject matter. What is the range of what we teach about? When we really think about it, our subject matter is really almost everything. We teach about the Earth in space and what is beyond the Earth, and few people on the planet really know much about this. Consider the significance of what we teach about. Almost everyone spends almost all of their lives worrying about what is immediately in front or behind. Most are completely absorbed with today, tomorrow, their work and bank account. Very few really know much about the vast universe--about almost everything that we really know exists.

I would like to see a survey done to see what percentage of humanity experiences the inspiration of a country, moon-less sky, filled with blazing stars. I think we would be astonished to learn how many never experience what has been one of the most highly motivating experiences leading to what we call science. I think the majority of people today live in cities, never go camping, and when they do go to a national park or other place of natural beauty away from cities, they roll the stone in front of the doors following the sunset. As my friend Dave Batch once told me, "the sky is on the endangered list."

Again, please consider a few favorite quotations. The Roman Posidinus referred to Man as "...beholder and expounder of heaven." It is basic to what we are to observe what is around us and to need to find explanations for what we see.

Plato said that, "Astronomy compels the soul to look upward and leads us from this world to another." As you look again at these words, think of footprints on the Moon.

Harlow Shapley said, "We are brothers to the boulders and cousins to the stars." Consider all the science that is involved in that beautiful expression of our relationships to rocks, stars, physical processes and time.

The father of modern astrophysics, Sir Arthur Stanley Eddington, said, "We started to explore the inside of a star; we soon find ourselves exploring the inside of an atom."

One simply cannot understand stars without understanding atoms.

Finally, the great philosopher Immanuel Kant wrote, "Two things fill my mind with ever new and ever greater wonder and reverence, the oftener and the longer I allow my mind to dwell on them--the starry heavens above and the moral law within me." Interpreting the sky for people and focusing stars on the theme of "Man in his environment," involves simultaneous attention of the mind to moral laws and the starry firmament.

Almost everyone understands almost nothing about almost everything. It is our job to help people become aware of and knowledgeable of almost everything. "WE MAKE A ROAD FOR SPIRITS, FOR THE SPIRITS TO PASS OVER. We are "HUNTERS WHO CHASE A BEAR," a lion, a scorpion--the Sun, the moon, the planets, the stars, galaxies, quasars, black holes--the entire universe. And, we hope, "THERE NEVER WILL BE A TIME WHEN WE ARE NOT HUNTING."

What is Most Important of All?

Considering all that we teach about--sing about--what is most important to most people? Probably all of us have been asked, "In your study of the universe, what seems most important to you?" Or perhaps it has been put to you this way. "If you could impart to others just one value coming from your study of astronomy, what would it be?"

I do not intend to know what answer you should, or would, give to these questions, but I want to tell you what my answer to this has become. If I could impart just one value to others, it would be that Earth is the jewel of all the universe to humans. When I think about the vast and interesting universe--the universe that might, or might not, be teeming with other intelligent life, I am completely overwhelmed by the feeling of amazement, astonishment and gratitude that we are here at all. Earth is so extremely minute--so vanishingly small--in the vastness of what we label as the universe, that it hardly exists at all. The fact that it does exist--that we are here right now as fleeting passengers on it--makes me value the Earth more than anything. I could no more throw a piece of non-biodegradable trash out the window--I could no more knowingly damage a natural landscape that others could be enjoying--than I could throw myself off a high cliff.

I think one of the profound values we can impart to others through our work is the realization of how very special Earth is. People can only appreciate this value in the way I refer to here when they realize something about how Earth fits into the really big picture. Teaching about the Solar System--about stars and galaxies, black holes and quasars, about the Big Bang, about entropy and gravity and nuclear forces, about hydrogen fusion inside stars, about nebulae and supernovae and stellar evolution, about the chronology of the Sun and its fleet of planets, about all these things and more coming together in a moment when we are here to look out at the stars and sing the next verse we discover about them--this is the way to help people realize how marvelous it is that Earth exists to nurture and protect us in order that we can continue to explore our potential futures that someday might even take us away from our home planet.

Again, here are a few quotations. You are all familiar with the first one, written on or about December 25, 1968. You know what was happening on that Christmas night when Archibald MacLeish wrote:

> To see the earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the earth together, brothers on that bright loveliness in the eternal cold--brothers who know now they are truly brothers.

Socrates taught about the need for people to see the big picture. His teachings of about 500 B.C. have been paraphrased:

> Man must rise above the Earth--to the top of the atmosphere and beyond--For only thus will he fully understand the world in which he lives.

Cosmologist Sir Fred Hoyle, in 1948, wrote, "Once a photograph of the Earth, taken from the outside, is available--once the sheer isolation of the Earth becomes plain--a new

idea as powerful as any in history will be let loose."

I do not even know how Louise Weber is, but I love her words, apparently written in realization of the numbers of stars that could have planets orbiting them.

I may inhabit worlds in time to come
Of finer substance, born of farther suns;
A greater glory I may one day see,
But Oh, today, dear Earth, how I love thee!

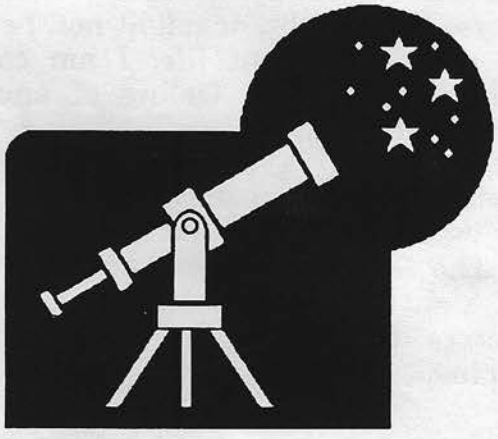
I want to tell you about a game I discovered while driving along one of the ribs of Mother Earth, along Skyline Drive in Shenandoah National Park. It was a weekday in the winter-time. I was practically alone on that highway that often is one long stream of cars. It was a beautiful deep-blue sky day. Trees stood out against the sky. I was thinking about others through time who had enjoyed this scene that I so quickly went through. And then, a thought hit me like a bolt of white lightning from the cloudless sky. "What if I had just dropped into that landscape from somewhere out there?" "What if I was from some other entirely different planet somewhere way off in the galaxy, or even from some other galaxy." Asking these questions--thinking this way--allowed me to see things differently. It was like all the details suddenly jumped out of the scene and into my range of vision. I wanted to stop and examine every detail. I wanted to get out a microscope and look at every stone and every tree, blade of grass and flower. The landscape came alive with detail I had never noticed in the same way before. This was because of the framework of the way I approached what was before me. If I had come from somewhere else, this moment would be the most exciting of my entire existence. It would be the culmination of so much effort and so much time--I would have traveled light years and waited my entire life to behold this scene. It would be completely new and fresh and I would be attuned to learning a whole new world of exciting new information. I would be the Captain Cook of the Earth, sent here to explore new places, species and creatures --boldly to go where no one had been before. I call the game, simply "alien." I commend it to you for your own enjoyment and as an idea to use in development of shows that could help people value the Earth in the great cosmos. Indeed, it is the basic idea used in Hansen Planetarium's current program development, "Cosmic Catastrophes," an interactive show where we ask audiences to take on the role of being the council on an alien spaceship coming in toward Earth as a possible planet to colonize.

In teaching about almost everything, we present a powerful framework for valuing the rest--the miniscule planet--that is almost everything to almost everyone, the only part of the universe most people will even know much about. It is vitally important that they know Earth in context with the great cosmos. We can accomplish this, for we can present a stars-eye view. "WE LOOK DOWN ON THE MOUNTAINS." It is our job to be able to do so. It is our job to see through the eyes of stars and to sing their song so that people can grasp the meanings.

We Sing the Song of the Stars

Those are the thoughts I wanted to share with you. We must always be seeking more effective methods to make the words of the song of the stars not only beautiful, but filled with clear meaning to those who come into our special theaters to hear the music. This is important because of the significance of the meanings hidden in the light--the voices--of the stars, and because of the fact that very few people even hear the song at all.

We ARE stars' way of knowing about stars. We are the singers. We are the birds of fire. We fly over the sky. Our light is a voice. We are the hungers who are able to look down on the mountains, and THIS IS THE SONG OF THE STARS!



WHY IS ASTRONOMY BORING?

by Richard McColman

Actually, of course, it's not. But to hear the reactions of some students, it would seem that modern science courses, including astronomy, are filled with a tedium unrivalled in the annals of education.

Why is there often such a reaction to subjects which we as science educators find so fascinating and essential? Why have American students fallen so far behind in science knowledge and proficiency when compared to those in Europe, Asia, and even the Soviet Union? Why are we in danger of becoming a third rate nation with respect to the science prowess of our high school and college graduates?

These are the questions with which we have all been wrestling--questions which echo down the corridors of our schools and over the airwaves of the nightly newscasts. And, no doubt, we have all heard various explanations for this deplorable state of affairs. They range from accusations that the educational system itself has become intellectually unchallenging and is on the verge of collapse, to allegations that our students have become a pack of tuned-out, undisciplined music-video junkies. Suggested solutions range from more standardized testing, to greater federal funding for education, to privatization of the education system itself.

While there may be limited merit in each of these approaches, it seems to me that they all fail to address the major problem--that we as a nation have in some ways made science education boring.

Gibbes conducts several planetarium sessions each semester as a service for the astronomy department of one of the local colleges. The basic course itself is set up in a rather peculiar manner. There are no lectures as such, except for the planetarium sessions--indeed no real class meetings at all, save for the occasional informal lab session run by a grad student. Now, what normally happens in this "self-paced" course is that each student is supposed to read a chapter in the textbook, and then drop by a room in the department curiously referred to as the "Astronomy Center." There, he or she takes the obligatory "Unit Quiz," a brief multiple-choice test designed (ostensibly) to assess the knowledge level of the guinea pig in question. If the student is able to correctly answer the requisite percentage of questions on the quiz, he or she passes that "unit" and moves on to the next. If the person fails to pass--no problem--he or she can simply re-take the test over and over again until a passing score is achieved.

Finally, upon passing the required number of units, said student gets credit for the course, with the grade dependent upon the number of additional units completed. If at any point the student encounters some difficulty understanding a concept, he or she merely tries to get an appointment with the professor--along with the several hundred other students in the course that semester. Of course one can always seek out a grad student if there's a problem getting hold of the professor.

Quite an interactive approach, eh!

Anyway, for one of the units, students come to the planetarium to get a fifty-minute lecture on "time and coordinate systems." At the end of the session, they are handed a ticket to take back to the aforementioned Astronomy Center. By merely returning said slip of colored paper, the student can get credit for completing one course unit. How very challenging!

Aside from the lackadaisical way that this unit is handled (as per specific instructions from the professor) I have real problems with such subject matter in a beginning astronomy class. To my mind, teaching celestial coordinate systems to beginning astronomy students, whether they be primary, secondary, or college, can be a formula for motivational disaster. For most of these students, such

subject matter is simply too abstract and too seemingly irrelevant to promote an appreciation for studying the universe. For those who might take offense at such a suggestion, let me point out my belief that celestial coordinates is indeed a legitimate and necessary area of study in astronomy. At issue here is not if, but when.

Think about it for just a minute. When we were kids, science held a particular fascination for most of us. Why else would we have gone into the planetarium field? But for most people who get hooked on astronomy, the initial turn-on comes not from calculating some abstract mathematical formula, but from the gee-whiz components in the subject--such as contemplating the enormous size of Jupiter or the Sun, the number of stars in the galaxy, the speed of light, or the distance and temperature of Pluto.

Later, but only after the astronomy "bug" had us incurably enveloped in its fever did we exhibit the intense motivation necessary to carry us through the process of learning the more laborious and abstract details of the subject. While some would have us believe that such is a sign of aberrant behavioral processes, it is, in fact, an exhibition of the curiosity which forms the basis of human creativity.

Albert Einstein is a good example of this effect. Although widely regarded as one of the greatest scientific minds ever, Einstein's initial educational performance was only lack-luster at best. When in elementary school, he did rather poorly in many of his students, particularly in mathematics. He was often accused of having an undisciplined mind, as well as a propensity for daydreaming in class. The very subjects with which he was to later make his mark as a genius, he found difficult in his youth. Werner von Braun's initial interest in rocketry now appears more like playful fooling around than the product of a disciplined, mathematical mind. Closer to home, my wife sometimes recalls how one of her high-school teachers informed her that she would never make it in college. Ironically, Kim is not only about to finish her master's degree, but has been chosen as teacher of the year at her school, was recently presented a NSTA Presidential Award for Excellence in Science and Mathematics Teaching, and conducts math workshops for teachers all over the country. Funny how things work out sometimes.

In essence, all of this makes perfect sense, though. Within the realm of human curiosity, emotional drive precedes intellectual investment, and interest in the general precedes motivation toward the specific.

Kids, adolescents, and even adults for that matter, are primarily motivated on a long-term basis by things that are fun. Our initial interest in a flower is an emotional one (it is pleasing to the senses), rather than being intellectual in nature. Likewise, our initial interest in astronomy has little to do with some arbitrary drive to measure and calculate, but instead to revel in the magnificent grandeur and wonder of the universe.

Interestingly, this phenomenon is borne out time and again in astronomer's accounts of how and why they initially pursued their studies of the heavens. The PBS series The Astronomers contains some good examples of this. When asked, time and again these men and women of science offer explanations which are strikingly more emotionally than scientifically based. Although their current day-to-day research would appear insipid and tedious at best to the novice, it is the culmination of years of study driven by a raw, almost primordial burst of passion early in their careers. Only later comes the intellectual growth and discipline required to wade through the minutia of higher level learning and research.

Because of this, I am appalled by the number of astronomy courses and science curricula that emphasize difficult and abstract facts and concepts early on. Celestial coordinates, I think, represents an area of study best left to second-semester college astronomy courses, and should be taught to only the most advanced and highly-motivated students in high school. Granted, while lower-level students may be able to grasp many of these concepts, one runs a very significant risk of alienating them from the general subject matter due to the void of emotionally -appealing content and the depth of abstraction. Besides, the only practical

THE STARS OF INDIA

by
Rick Williamon

Fernbank Science Center
Atlanta, Georgia

STARS OF INDIA

Production Note: *Begin credits and fade house lights; bring up scenes of India. Do not turn on stars,. As the scenes end, fade up the all-sky Hindu temple, begin Hindu wedding chant by the priest. When the Hindu temple reaches full brightness, lower the Hindu chant to background under the English version.*

Narrator 1: "Molded in the spirit of the Macrocosm,
Reminded of the nature of the Universe,

All-sky Temple with Wedding Pavilion

Resting on the back of the great Tortoise,
Balanced by the thousand heads of the great serpent,
Navigated by the sharp sight of the Elephants eight,
Surrounded by the constellations twenty seven,
Protected by the nine planetary influences,
Ruled by the Lords of the eight corners,
Resplendent is the jewel bright and shining,
The pavilion for this wedding."

Narrator 2: We have joined a ceremony, actually a celebration, steeped in tradition and custom with rules and procedures outlined by texts written in the ancient sacred language of Sanskrit. We have joined a Hindu wedding ceremony! And we are just in time. Complying with instructions written in about 1500 B.C., the priest has just defined where within the universe this ceremony is taking place.

Dissolve into Pavilion

Father giving Instructions

Hindu Universe

And although our location upon the back of a tortoise, guided by eight elephants, and balanced by serpents may seem odd, you should realize that these were symbols used by ancient Hindu scholars. The tortoise was the symbol of a slow, deliberate motion; the coiled serpent represents rotation; the eight elephants are the cardinal directions, north, south, east, and west, as well as northeast, southeast, southwest, and northwest. Each of these eight directions is ruled by a god. Stripped of symbolism, the complete description of our location, as given in the Sanskrit texts, clearly tells us two things. First, the ancient Hindu astronomers knew that the earth rotated on its axis. Second, they knew the Earth moved, that is, was guided by the compass gods, around the the sun once a year.

Compass Gods

Orrery

Production note: Bring up the lords of the cardinal points in the zenith during the above. Then fade with a four second pause and head to the temple again.

Narrator 2: Soon the priest will offer prayers to the God Almighty and all his representatives, the pantheon of gods. The Sanskrit scriptures from which the prayers are taken are a collection of ancient writings. Between about 1500 B.C. and 500 B.C., four collections of hymns, incantations, and sacrificial formula, called Vedas, were composed. In addition, other Sanskrit writings date from several centuries B.C. until about 1000 A.D. These later works include the Puranas, which contain thousands of legends and myths. But it is the Rig-Veda that contains the earliest known hymns for the gods; hymns intended to be poetically chanted with deliberate cadence.

Prayers by Priest
Library (Sanscrit)

Vedas & Puranas

Dissolve priest

Production Note: *Use Indian chant for the three verses of Hymn of Man. Use Kodalith to show English and Sanskrit verbage during the chants.*

Narrator 2: Collectively, these Sanskrit texts tell of how the universe was created by one god,

Statues

Brahman. In broadest terms, Brahman would have been somewhat like the single god worshipped by Christians and Jews, or Allah by Moslems, or even Buddha by Buddhists. But unlike other religions, the Hindu believed that Brahman created everything out of himself, including the other gods. In turn, these gods had children; and finally these children and offsprings became the thousands of gods and goddesses that dominate Hindu life. These gods and all beings, including man, are simply "parts" of Brahman.

There are two other important beliefs in Indian philosophy. First, everything occurs in cycles. Birth, life, and rebirth is universal; such a cycle applies not only to humans, but to everything - including the universe itself!

Another key belief is reincarnation; that is, each and every living thing will return in some future life. Even Lord Vishnu, the god who created the other gods according to the desire of Brahman, will be reincarnated in later universes. Moreover, during the wedding ceremony, the priest and families offer prayers to Lord Vishnu and consider the groom to be a representation of Lord Vishnu himself.

Dissolve - **Priest Preparing Parents**

In order for the wedding to continue, the bride's parents must prepare special vessels, called kalashas, and invite the goddesses of all the sacred rivers to contribute and fill the vessels with their waters. More than merely cups or containers, the kalashas are

Kalashas

vessels which transport the river goddesses themselves. These waters are then purified by the priest and are used during the entire ceremony. Upon one kalasha are images of the goddess Lakshmi, the goddess of wealth, who is depicted in several forms, symbolizing good fortune, prosperity, health, knowledge, beauty, grace, happiness, and success. It is believed that Her devotees, purified by water from this kalasha, will be

Lakshmi

thus protected by Lakshmi.

Dissolve - **Father Washing Feet**

The father has just respectfully washed the feet of his future son-in-law, and thus the groom has been prepared and purified for the wedding and for his incarnation as Lord Vishnu. As we rejoin the ceremony, the priest, as required by tradition given in the

Dissolve - **Priest Reciting History**

Sanskrit instructions, is about to recall the history of the universe since creation, and shall soon identify the space and time coordinates of the present event in relation to the sacred places and times.

Production note:

Throughout the above, use the chanting priest and the Hymn of Origin as background. Then raise the priest/ music to narration level during the last part of the above narration. Feature this for only 7 seconds, then start narrator below, fading priest/ music to background.

Fade to darkness

Narrator 1:

In the very beginning there was nothing but Brahman, the unmanifested creator; that is, the almighty creator who was without form. Brahman was the soul of the universe. Time itself was without beginning and without end. It came to be that from this vast

Cosmic Egg

emptiness were fashioned many Cosmic eggs. One of these cosmic eggs, Brahmanda, contained everything needed for creation. Deep within the yoke could be found the

Egg Structure

structure of everything that was to come. There were fourteen distinct worlds, seven in the upper regions and seven in the lower, with the middle region occupied by the earth. When the golden embryo broke open, a vast, infinite expanse of ocean encompassed

Moving Mirror - **Baby Vishnu on Banyan Leaf**

everything. But there, afloat upon a leaf of a banyan tree in this chaotic expanse of water, was a small, happy boy. As the child became aware of his existence, he was overpowered with the idea of creation. The child began to grow, and soon a lotus

Dissolve - **Lotus Growing from Vishnu's Navel**

sprang forth and grew from the child's navel. The child turned out to be a reincarnation of the great god Vishnu, and from the lotus vine growing from his body

Brahma

was born Brahma, who then created the rest of the Universe on behalf of Vishnu. Other gods were created, along with the Earth (one second pause); the sky (one second

Rotating Earth Stars On

pause); clouds were created, which were considered to be celestial cattle; and oceans, one of which was believed to have been made of milk.

Day of Brahma

But all things are cyclic, and the current Universe, as created by Brahma, will last for only a day. Of course, this day is a "day of Brahma," which is a period of 4, 320, 000, 000 years known as a "kalpa."

Amorphous Cloud

At the end of the "day of Brahma," the Universe is dissolved. That is, all matter will be reabsorbed into Brahma. Brahma will sleep for a "night of Brahma," and then will awaken for another "day" of creation. These cycles of creation and dissolution will continue for 100 Brahma years. Finally, after 100 years of Brahma, that is, after 3,110,400 million years, everything, including Vishnu himself, will merge into Brahman, the unmanifested creator. This grand destruction is known as the "grand deluge." There have been many Vishnu's and many Brahma's, but only one Brahman, the creator without form. The eternal Brahman is the soul of the universe. But even in this distant future the universe will not vanish. After the embryo of Vishnu has slept sufficiently within the cosmic egg, Brahman will awake Vishnu and Creation will start anew. Time itself <u>is</u> Brahman.

Narrator 2:

In the universe of the present Kalpa, according to the Sanskrit texts, there are several versions of how Earth and its creatures were brought into their final form. One story that is told in all parts of India is referred to as "the churning of the ocean of milk".

Brahma

Soon after Brahma grew from the lotus bud, he began creating other gods. These gods were not immortal, and many generations of gods came into being and then died. But more than this, not all of these gods were "good"; that is, there was quite a bit of trial and error on the part of Brahma as he added "living beings" and "things" to the universe. So there were not only gods, but also demons. Many stories and episodes were told of how the gods and demons fought and argued, but, finally, gods and demons alike grew weary of the constant conflict and turmoil. Seeking advice from Vishnu, the gods were directed that they should seek peace with the demons. Futhermore, Vishnu suggested that the gods and demons should churn the ocean of milk. In the same way that solids, such as cheese, will form from milk churned in the normal way, it was expected that many wonderful things would rise to the top of this churned ocean of milk. Vishnu assured them that even a wonderful elixir, a magical nectar, would come forth which would make one who drinks of it immortal. And so it was, with immortality as a possible reward for everyone, the gods made their peace with the demons.

Ocean Panarama

Gods & Demons

Gods & Demons with a Giant Chruning Rod (A Mountain)

Gods & Demons with Serpent

The gods and the demons straightway began to equip themselves for the churning of the sea of milk, hoping by this operation to bring to the surface everything solid within the sea, including the cup containing the marvelous nectar. First they needed a stirring staff long enough to reach the depth of such a churn, so they wrenched a tall mountain out of the earth. Then they asked the serpent, Vasuki, to act as a churning cord. The enormous snake consented, but only on condition that in return he should have his share of the nectar. And so Vasuki was wrapped around the mountain, with the gods on one side and the demons on the other.

Turtle

Gods with Turtle

The battle between good and evil was ready to proceed, and the churners, pulling each their own end alternately and in cadence, began to churn the sea with all their might. But with the first pulls the mountain, lacking support, dropped into the ocean. It was then that Lord Vishnu intervened, turned himself into a giant sea-tortoise, and placed himself under the mountain. The two crews then effectively went about their task. Still, there was one critical moment. The very first thing to be churned from the sea of

Lord Siva	milk was a deadly poison. Had this poison overflowed into the ocean, every living creature would have been destroyed, including the gods and the demons. Happily, the great god Siva was on the watch, and caught the poison in his hand and swallowed it without taking any harm, except for scalding his throat. This is why the god Siva is always seen with a blue throat. It is believed that the poison remains within his throat even to this day.
Cow **Horse** **Elephant** **Gems** **Trees** **Maidens** **Chandra** *Rising projector -* **Nectar**	Meanwhile, the gods and the demons churned away. One of the first things to rise to the surface was a beloved cow, who was to become the Goddess of Abundance. (1/2 second pause) Next came a beautiful moon-colored horse. (1/2 second pause) This was soon followed by a magnificent white elephant, quickly taken by one of the gods as his steed. (1/2 second pause) Perfect, sparkling rubies came forth from the sea, immediately taken by Vishnu himself to adorn his breast. Then trees emerged which were capable of giving delicious, nourishing fruit. Next were beautiful maidens. (1/2 second pause) Then the moon! That is, Chandra, the god of the moon, rose from the sea of milk. (1 second pause) He was followed by a quantity of treasures, and a thousand more or less fabulous beings. And then, carrying a lotus flower in her hand, was ravishing Lakshmi, the most beautiful goddess ever created. She was later to become the loving wife of Vishnu. Finally, the very last thing to rise to the surface was the god Dhanvantari, holding in his hand a cup of foaming, sparkling nectar.
Narrator 2: **Beautiful Maiden** **Row of Gods & Demons** **Gods Together** **Beheaded Rahu** **Rahu & Ketu**	With immortality almost within their grasp, everyone dashed towards the nectar. And .. the demons won. Again Vishnu intervened, this time changing himself into a maiden so beautiful and enchanting that neither gods nor demons could take their eyes from her. Everyone was so enchanted that all wholeheartedly agreed to allow her, the illusion of Vishnu, to take charge of the nectar. She made the gods and demons sit in separate rows facing each other, and she was to allow everyone to sip immortality from the cup. And while everyone was potently enchanted with her beauty, she gave all the nectar to the gods, thereby cheating the demons of their promised eternal life. That is, all but one demon, named Rahu, who had disguised himself and entered the row of gods between the Sun and the Moon. Just as Rahu sipped the nectar, he was discovered by both the sun and moon. Immediately Vishnu, still disguised as an enchanting maiden, threw a deadly discus and beheaded Rahu. But the damage was done, and the demon Rahu even now continues to bedevil the informers, the sun and the moon. The head of Rahu became a "shadow planet," called "Rahu." The body of the demon Rahu became a second "shadow planet," called "Ketu." Around the time of new and full moons, these unseen "shadow planets," Rahu and Ketu, will sometimes intervene and cause an eclipse of either the sun or moon.
Eclipse Photos **Lunar Eclipse** **Eclipse Diagrams**	Today we know that eclipses are caused by neither the head nor the body of the demon Rahu. Eclipses of the sun and moon are caused by exact alignments of the earth, sun and moon. As the moon orbits around the earth once a month, it must pass generally between the earth and sun. This will be the time of new moon, when the nighttime side of the moon faces the earth. Most of the time the moon will pass slightly above or below the sun as seen from earth. However, there will be times when the moon will be perfectly aligned with the sun, and the shadow of the moon in space will be cast upon our planet. Such an event could have been predicted accurately by (slight pause) using an imaginary, unseen "shadow planet." Likewise, an eclipse of the moon, which occurs when a full moon passes through the shadow of Earth, could be predicted effectively by a "shadow planet". Even today, Hindus use the two shadow planets for predictions and calculations.
Production note:	*During the churning scenes above, move the latitude to +90 with the stars off, and then use fast daily motion during the actual churning. Use an ocean Zeiss pan, and project objects (white*

elephants, horses, etc.) as they are churned up from the sea. Fernbank art will show the lining up of the gods and demons while passing around the cup, and, of course, we'll have to decapitate Rahu in a non-offensive way. i.e. - do not turn up the bloody red lights, etc.! Then use a few real eclipse shots and maybe a drawing of what does happen with the sun and moon during an eclipse.

Narrator 2:
Ecliptic & Equator

We can check to see if Rahu and Ketu are still at work in the heavens today. There are two segments of circles across the sky. The first is the celestial equator. If you imagine the equator of Earth expanded from Earth and out into space, the location in the heavens would become the "celestial equator." Just as with the equator on earth, you can measure objects north or south of the celestial equator in the sky. The dotted path across the sky with dates is the ecliptic, the sun's highway through the stars during the year. You can keep up with the date by noting the sun's position along the ecliptic. It's the earth, of course, which is moving, and not really the sun. But we cannot "feel" the movement of the Earth. So, as Earth orbits the sun once each year, we "see" the sun shift its position against the very distant stars.

Sun on with Annual Motion

Planets & Moon

However, there is more. The planets and the moon also shall be found near the ecliptic. The planets, in orbit around the sun, are very much like marbles rolling around on top of a table. That is, they are all in almost the same orbital plane as the Earth's orbit around the sun.

Saturn

Low in the southwest you can find the ringed beauty Saturn, one of the gas giant planets, some 9 1/2 times larger than Earth. The robot probes, Voyagers 1 and 2, revealed finely structured rings surrounding a cold, smoggy, stormy world made mostly of gas. Saturn is the ruler of at least 18 moons, most of which are made of water ice.

Mercury

Next to the sun you can find elusive Mercury. Because Mercury orbits so close to the sun, it's never seen very far from our brilliant solar inferno. So, most of the time, Mercury is lost from view in the glare of the sun. Photographs of Mercury, televised to Earth about 20 years ago, reveal an ancient, heavily cratered surface, closely resembling the moon. Such craters are the scars left by countless, relentless collisions that mainly occurred during the first billion years of our solar system's existence.

Venus

The other planet near the sun is beautiful Venus. This is a world about the same size as Earth, but there the resemblance ends. Venus is covered with thick, dense, poisonous clouds made mostly of carbon dioxide and laced with a haze of sulfuric acid. The thick clouds act like a blanket, triggering a runaway greenhouse effect and driving the surface temperature to almost 900 degrees Fahrenheit. With robot probes and with radar we have found mountains, valleys, craters, and strange grooved terrain. This is a terrestrial inferno we humans shall never visit; an earthly visitor first would be poisoned, then crushed under the tremendous weight of the atmosphere, and finally incinerated in the 900 degree oven.

Magellan Photos of Venus

Mars

Farther to the east is the red planet Mars. Covered with rusty, red soil, this planet has several huge volcanoes, polar ice caps, and a chasm that dwarfs the grand canyon of Earth. In 1976 Mars was visited by two Viking spacecrafts, which, in turn, televised detailed photographs back to Earth. In spite of the thin Martian atmosphere and extreme cold, this will be one of the very few places within our solar system that our astronauts will someday visit.

Ketu

The next planet, towards the east, is one of the shadow planets, in this case, Ketu. It is indeed invisible. However, you can discover its location by looking at the moon. As

the moon orbits the Earth, it will always be found near the ecliptic. Sometimes the moon will be located above the ecliptic; sometimes below. Ketu is therefore located at the place on the ecliptic where the moon crosses in going from north to south. That crossing point at this moment is located at the 20 July position on the ecliptic.

Rahu

Rahu, the other invisible shadow planet, is on the opposite side of the sky, defined by the location where the moon passes from south of the ecliptic to north. Ketu and Rahu are always found somewhere along the ecliptic, and are always roughly opposite each other in the sky. And both are slowly moving. Look at the moon once again, and note how on May 12 it passes just above the sun. As the moon continues its orbit around Earth, it again crosses the ecliptic from north to south. But now the crossing point has moved to about July 17. So now we know that Ketu is moving slowly westward along the ecliptic.

Jupiter

In the eastern sky is brilliant Jupiter, by far the largest of all planets. This gas giant world controls at least 16 moons and boasts the largest hurricane in the solar system.. Called the "Great Red Spot," this storm is over three times larger than Earth, and has been raging for centuries.

June 15, 1991

Meanwhile, the moon will pass just above the sun on June 10. Then, around June 15, the planets Jupiter, Venus, Mars, and the moon will all be located just to the east of the sun. That means that shortly after sunset, this beautifully clustered group of planets and the moon will follow the sun down in the western sky. Such a grouping is not really rare or astronomically significant, but should be considered unusual and certainly worthwhile to view. As the moon continues, it once again crosses the ecliptic from north to south, this time at the July 14 position.

Start Annual Motion

Dates

Recall how close the last new moon passed above the sun. Next month the new moon will pass directly in front of the sun and a solar eclipse will occur. Also, recall that the positions of Ketu had been identified by the moon's crossing the ecliptic at the July 20, July 17, and the July 14 positions. Thus each month the location of invisible Ketu has shifted about 3 days to the west. This means that the next north to south crossing of the ecliptic by the moon will occur on -- July 11. It is a straightforward task to calculate the rather uniform motion of Ketu. Moreover, if one accurately follows the position of the sun, eclipses can be accurately predicted.

Stop Annual on 11 July, 1991 and Start Eclipse

The moon is indeed destined to rendezvous with the sun on this eleventh day of July, 1991. Or, in other words, on the 11th of July, Ketu keeps his ancient appointment, and exacts his revenge against the informer sun.

Production Note:

During each of the planets above, show Kodalith of the planet with Indian name and Sanskrit. Also highlight key dates Finally, of course, run the solar eclipse. Timing will be a problem, of course. We can stop all motion on June 15 and adjust from there, and we can backtime from the 20th of July position mentioned above.

Narrator 3:

The path of totality for the July 11, 1991 eclipse will begin near Hawaii just after sunrise. Then the totality path will cross Baja California, southern Mexico, and finally South America, where the Brazilians will watch the eclipsed sun set. From Atlanta, a maximum of only 28% of the sun is blocked by the moon at 3:30 p.m., E.D.T. After the eclipse, the moon continues eastward in its orbit around Earth, and Ketu continues westward its invisible orbit along the ecliptic.

Annual on after Eclipse

Orrery	As for the other planets, their motions only seem more complicated, shifting sometimes to the east and then to the west. If we lived on the surface of the sun, then all planets, including the Earth, would move uniformly to the east against the background stars. Fortunately, we do not live on the sun, but upon a comfortable planet moving at a speed of 18 1/2 miles per second around the sun. From our rapidly moving observation platform, the Earth, we sometimes pass by slower moving planets. On such occasions, these planets will appear to stop their eastward motion, move "backward," or westward, and then resume their eastward motion once again. All of the seemingly erratic motions of the planets can be accounted for by considering the motion of the Earth.
Lunar Phases	Finally, the moon! Our silvery moon has been the subject of countless romantic poems as well as the target of intense scientific investigation. The moon's phases are simply due to day and night on the moon. That is, the part of the moon that you see is day, the part you do not see is night. It's just this ever changing perspective that excites our imaginations. As lunar phases wax and wane, the sun's light casts ever changing shadows on the surface of the moon, highlighting different details of craters and mountains from one phase to the next. At full moon, some people see a "man in the moon," some see a woman, others a frog, and still others a rabbit, or hare.
Craters	
Zoom - **Full Moon**	
	Throughout India, a deer is the most common animal seen on the moon. Now, in southern India, there are people who tell a tale about why it is a hare, and not a deer, that they see.
Ape, Hare & Fox	Long ago in India a Hare walked through the woods one day with his friends, an Ape and a Fox.
Rabbit Narrator:	"It is a beautiful morning!"
Narrator 3:	said the hare. And the three went along talking of the weather and other pleasant things. They walked and they walked and finally met a beggar. He was in fact, the dirtiest, poorest beggar they had ever seen.
Dissolve - **Standing Beggar**	
Rabbit Narrator:	"Old man, we have nothing to give you. We've not even thought of food on such a beautiful morning."
Narrator 3:	But the beggar pleaded, "Kind sirs, please help me." The hare looked him once again, and said:
Rabbit Narrator:	"We shall have to hunt for something for you. You sit there in the shade and wait."
Dissolve - **Sitting Beggar**	
Narrator 3:	All day long the Hare, the Ape and the fox hunted for food. As evening approached, the Ape returned with his gift; a bunch of ripe yellow mangoes. "You are very kind," said the beggar. Soon, the fox returned with his gift, a bird's nest filled with eggs. "You are very kind," the beggar thanked him. And then the hare returned without anything. Very sadly he explained:
Ape & Fox	
Hare	
Rabbit Narrator:	"I hunted and hunted, but I could not find anything."
Narrator 3:	Then the Hare had an idea! Hurriedly he gathered sticks and made a fire. As the fire flamed up brightly he turned to the old beggar and quietly said:
Rabbit in Fire	

Rabbit Narrator: "Now! Now there shall be something for your supper!"

Narrator 3: And before anyone could say anything, the hare jumped right into the fire. The beggar stood up. He waved his crooked stick over the fire until the flames died down. The Ape and the Fox stared first at the fire and and then at each other. The fire hadn't burned their friend at all! Then they looked at the beggar, but he was a beggar no longer. He was the great god Indra, the god of thunder! Indra spoke to the hare, "Because you were willing to give your life to feed an old beggar, you shall dwell forever in the skies where all men can see you and remember your kindness." And if you look at the full moon, you will still see the Hare, right where Indra placed him.

Dissolve - **Beggar with Crooked Stick**

Dissolve - **Indra**

Full Moon

Production Note: *In addition to the obvious art needed in the above, use a photo of the full moon and with dissolve show the location of the rabbit. And then, as the full moon zooms up, fade out everything else and then fade out the moon as the temple fades in. During this time, reset the sky for the next part, the facing towards the big dipper by the bride and groom. Make sure that the sun will be above the horizon as well as the big dipper and also the Pleiades.*

All-sky **Temple with Pavilion**

Begin "Hymn of Man" as background for the fade-in of the temple.

Narrator 1: "Having finally been born into this human life because of some good fortune after several different kinds of lives,
to clean myself of the nine different kinds of sins I might have committed since my birth either through thought, word or deed, knowingly or unknowingly,
to please the almighty god
to obtain permanent residence in Brahmaloka
to obtain permanent residence for ten generations of my ancestors before me and after me in Brahmaloka,
in my house according to the accepted tradition, I give my well decorated daughter along with gold and waters away.

Dissolve - **Seated Parents**

Dissolve - **Father of the Bride**

Narrator 3: The focus of the entire ceremony is a carefully calculated moment, called muhurtham, which is based almost entirely upon the positions of astronomical bodies. At this most sacred and important moment, the gods, the heavens, the earth and the seats of knowledge and prosperity are all in consonance, ready to bless the couple. At this moment, with a curtain between them, the bride and groom place their hands on each other's heads, with a symbolic mixture of sweet and bitter tastes in their palms, while the priest invokes the powers of the gods to provide stability and continuation to their married life. Muhurtham is the Moment of wedding. After this moment the curtain is lifted, and the bride and groom are proclaimed married by the priest!

Dissolve - **Curtain Down**

Dissolve - **Curtain Raised**

As the newly married couple now face each other as man and wife, the bridegroom next places the necklace of wedding medallions around the bride's neck and then ties a sacred rope around her waist. As the celebration continues, they exchange rings (1 second pause) and each pours rice over the head of the other. And then the priest symbolically ties the ends of their upper garments in a sacred knot.

Dissolve - **Medallions**

Dissolve - **Rice on Heads**

At this point the celebration is far from over, for several traditional steps still remain. The god of fire, Agni, must now be recognized and honored. This is done by the lighting of fire by the bride and groom. Agni is considered to be the messenger from heaven. The bride and bridegroom next take seven steps together around Agni; that is, around the fire. After the seventh step they take the following vows:

Dissolve - **Fire**

Dissolve - **Steps around Fire**

Bride and Groom: "By walking seven steps with me you have become my friend. With these seven steps we have become friends. I am blessed with your friendship. I shall always be with

you. You shall always be with me. We shall live together. We shall shine with pure hearts and love each other. We shall plan and act together. We shall combine our minds in our thoughts. We shall combine our hands in our actions."

Dissolve - **Facing Dipper**

Narrator 3: The newlyweds now pay homage to the seven sacred sages of the universe, represented by the seven stars in the big dipper region of the constellation, Ursa Major. This is done by having the couple face the big dipper, even if the ceremony takes place during the day. Stars are always above us, even during the day. Normally, our sun totally overpowers the fainter starlight. That's because the blanket of atmosphere around Earth scatters part of the sun's light back into the sky, making the sky bright and blue. The unusual view you now perceive is possible only from space, where there is no atmosphere to scatter the sun's light. For the moment, here in the planetarium, we shall let stars, sun, moon, and planets all remain.

Sun On
Fade Temple
Stars On

Production note: We'll need about a **three second pause between paragraphs here!** During the above description, fade the temple to about 1/3 brightness and bring out first the sun and then the stars. Leave the couple facing Ursa Major, and at the end of the paragraph fade the temple the rest of the way down. Turn Zeiss clouds so that they are barely seen as ghostly images drifting across the sky.

Narrator 3: Look to the Northeast! You can find the familiar big dipper with a handle made of three stars; and a bowl made of four more stars. The seven stars of the dipper represent the seven sacred sages. In Indian culture, some of the stars are souls of humans who, after living exceptional lives, have been reincarnated into the heavens.

Point Dipper

But many of the brighter stars are more than **mere mortal** souls. Such is the case with the stars of the big dipper. Shortly after Brahma started creating the Universe, he realized he could use help with this monumental task. Thus Brahma created several very wise sages to assist. Today we find these seven sages as the seven bright stars of the big dipper.

The bride and groom are instructed to face one particular star in the handle of the dipper. This is the star Mizar, and close inspection will reveal a companion star, named Alcor. In Indian culture this companion star is Arundhati, the perfect wife.

Point Alcor & Mizar

All seven great sages were wed, and once the other six wives, like Arundhati, stood beside their celestial husbands. According to ancient accounts, Agni, the god of fire, was filled with passion for all seven of the wives. However, Agni controlled himself and kept his passion hidden within. And this is where the story would have ended, except that the goddess Swaha, overheard Agni as he talked to himself about his secret passions. Now Swaha, herself, was filled with passion for Agni and secretly followed him, hoping to find a way to enamor him. And so it was, Swaha overheard Agni talking to himself about his secret desires for the wives. Swaha immediately changed herself into the form of the wife of the first sage. Swaha, now in her new form, approached the unsuspecting Agni, and soon her passion was fulfilled. This scene was repeated again and again, and much to the amazement of Agni, a fourth, fifth and sixth time, each time with a different wife. But the seventh wife was Arundhati. Swaha tried and tried, but she could not take the form of Arundhati. Arundhati's devotion to her husband was simply too strong for Swaha. Her devotion could **not** be overpowered by passion and desire.

Agni

Swaha

Swaha as Wife

Agni and Wives

Arundhati

The six wives were punished, of course, for allowing their Swaha to take each of their forms. They were taken from their husbands and banished to another distant part of the sky. You can see them now if you look to the West. Here we find a small, dipper

Point Pleiades shaped cluster of stars more commonly known either as the Pleiades, or as the "seven sisters," although only six stars are easily seen. The Pleiades, or seven sisters, or six wives; call it what you will, reveals itself with a long time exposure photograph to be a

Pleiades beautiful cluster of over 200 stars. These are thought to be young stars, only a few tens of millions of years old. As you can see, even its baby blanket of blue gas hasn't yet been completely discarded.

Meanwhile, Arundhati remains across the sky in the big dipper with her husband as the eternally faithful companion. Arundhati is the perfect wife.

Bride: "When the seven sages accepted Arundhati, the first among the wives, as the stable one, the rest of the wives accepted her preeminence. By looking at Arundhati, this bride shall **flourish** as the **perfect** wife."

Narrator 3: Of the many Indian star myths, one of the most famous concerns Dhruva, the pole star. Dhruva was a boy prince destined to rule the universe. But his situation in life was complicated by the fact that his father had two wives. One was his mother; but it was the other, the second wife, that was his father's favorite, and therein lay the problem. This second wife also had a son who received much better treatment than poor Dhruva.

Dhruva & Father One day the other son was sitting in the father's lap. Dhruva approached his father and also wanted a place in his lap. All might have ended happily, except the favorite wife stepped in and proclaimed: "You do not deserve a place in your father's lap; you, Dhruva, were not born to me!" Poor Dhruva began to cry, and his own mother could barely console him. She instructed Dhruva to worship Lord Vishnu. This he did, and

Dhruva Vishnu was so pleased he granted Dhruva his greatest desire. "Please allow me to attain a place where no one has ever reached," wished Dhruva. And so it was, after his time as the ruler of the universe, Dhruva was placed in the sky at the pivot of the

Point Polaris heavens. You can find Dhruva, the pole star, by starting with the seven sages. or big dipper. Use the two end stars in the bowl of the dipper as an arrow (slight pause), and extend the arrow about five times in length. The first reasonably bright star is Polaris, the north star, - or Dhruva.

Polaris Diagram Polaris isn't a very bright star; there are 48 other stars that we can see from Earth that are brighter. Moreover, Polaris is not quite what it seems to be. Polaris isn't a single star at all! Instead, like many stars in the heavens, it's a double star. The brighter of the two stars is a giant star, about 1600 times more brilliant than our sun, yellow in color and - slightly variable in brightness! The smaller, bluish companion, bound by gravity, circles its master every 2000 years. The Polaris star system is about 360 light years away, and both stars are each much larger than our sun. Nevertheless, Polaris <u>is</u> located at the "pivot of the heavens," and it should not be unexpected that help from Dhruva, now reincarnated in the heavens, is sought on behalf of the bride and groom.

Narrator 1: "Oh Dhruva, you have a stable location. You are the source of stable things and the cause of stability for the rest of the stars. You are the fulcrum about which the stars move. From your heavenly position, protect these two from those who act against them."

Narrator 2: Almost every aspect of this wedding celebration, from the setting of the date and time to the actual procedures of each step, is in some way guided and dictated by celestial events. For that matter, celestial positions and events dictate the guiding calendar for <u>all</u> everyday Hindu activities..

Ecliptic

Look again at the ecliptic, the apparent path of the sun through the stars. In Greek and Roman mythology, this path was divided into twelve parts, or constellations, collectively called the zodiac. The ecliptic and also the zodiac make a complete circle around the sky, with only about half of each visible at any one given time. You can see six of the twelve zodiac constellations above you now; they're outlined in red in our planetarium sky. Many cultures, including the Greeks and Romans, used the position of the sun as it passed through the zodiac constellations, to mark their calendars and gauge the passage of time. But this is a very difficult measurement; the brightness of the sun makes it extremely hard to determine exactly when the sun enters a given constellation. So, instead of the sun, Indian astronomers used - the Moon.

Constellations - All-Sky

Indian Zodiac Figures (*Skyline*)

You are surrounded by the zodiac constellations as envisioned by Indian astronomers; they are the same as the Greek and Roman patterns, although the pictures are strikingly different. During the course of the year the sun would move, for example, progressively in front of the stars of Aries, the Ram; Taurus, the bull; Gemini, the twins, and so on. Indian astronomers actually divided the twelve constellations of the zodiac into twenty seven pieces. These twenty seven divisions are asterisms; that is, these twenty seven figures are not recognized as individual constellation patterns, but only parts of constellations.

27 Lunar Asterisms

Moon Phases

But why twenty seven? That's because the moon takes about twenty seven days to orbit the Earth. Let's start with the moon in its full phase; the time when the moon is directly opposite the sun in the sky and we see the full daytime half of the moon. The orbiting moon wanes until 3rd quarter, when half day and half night is seen from earth. Next, the moon passes between earth and sun, revealing only the nighttime half of the moon to earthlings. Continuing onward, the moon will reach 1st quarter, again presenting half day and half night; (one second pause) and finally it reaches full phase again.. The total time for one complete trip around earth is about 27 days. 27 days; 27 asterism; the moon does indeed pass through one of the asterisms each day.

Synodic Period

At this moment, something should seem a bit strange. The time from one full moon till the next full moon is not 27 days, but 29 1/2 days. The moon indeed orbits the earth in about 27 days. However, the earth is simultaneously in orbit around the sun. This means, because of the Earth's motion, the moon will not yet be full after only 27 days. The moon has to actually travel a bit farther in its orbit. A few more days must elapse until it again aligns opposite the sun - and is full. So the cycle of lunar phases is 29 1/2 days, about the length of a typical month.

Moon On Annual Motion

Hindu Calendar

That means each day, the moon, relentlessly traveling eastward through the stars, will pass through one of the twenty seven lunar stations. Unlike the sun which is very difficult to observe, the moon can easily be followed and timed as it silently glides from one asterism to the next. In a Hindu calendar, the moon's phase and asterism for the day is given along with times of sunrise and set, the positions of the visible planet, and finally the locations of Rahu and Ketu.

Chandra

Mythologically, the moon is Chandra, one of the gods churned from the sea of milk. Each asterism is associated with a wife of Chandra. He had his favorite among his twenty seven wives, of course, but he dutifully spends one night every month with each of his wives.

Planets On

As for the planets, their positions can be easily predicted and, except for Rahu and Ketu, monitored as they pass from constellation to constellation and from asterism to asterism. The various positions of the sun, moon and planets as well as the position of sunrise are each assigned a numerical values. A rather straightforward numerical

procedure will yield whether the time is "favorable" or "unfavorable" for a particular Earthly event. The time of Muhurtham, the most favorable "sacred moment," is strictly dictated by celestial positions.

Production Note: *At some point during the above, we will be running annual motion with sun, moon and planets all on. I would like to use a latitude shift to +90 at some point in the above narration (without any explanation), in preparation for the next passage.*

Narrator: In yet another myth, the entire northern sky is envisioned as a giant porpoise. Dhruva, the north star, is the very tip of the tail, and the head is coiled downward toward the horizon. The seven sages are located upon the porpoise's hip, and the body extends along an arc that sweeps through several familiar zodiac constellations such as Leo, the lion, and Taurus, the bull. Finally, the head is located in the region of Sagittarius, the archer, and Scorpius, the scorpion. The eyes of this celestial porpoise are the stars Altair, in constellation Aquila the eagle; and Antares, in the constellation Scorpius, the scorpion. All the remaining stars represent hair, covering the porpoise's body.

Production note: *The above giant porpoise will be projected with an all sky projection. As the porpoise is fading, bring in the Jaipur Observatory skyline.*

Narrator 3: **Jaipur Skyline** You are surrounded by the structures and instruments of one of the most amazing astronomical observatories. You are in the city of Jaipur, in northern India, and this is the Jantar Mantar observatory constructed in 1728 by Sawai Jai Singh. In his youth, Sawai Jai Singh felt compelled to confirm the previous findings of the sages about reckoning time. Strangely enough, he was inspired by the naive questions of a young

Jai Singh girl about how far were the stars. As a young man, he built his first observatory just outside of Delhi. While the other nobles spent their time in court, Jai Singh spent his time trying to comprehend the cosmos. When he designed his new capital at Jaipur, he

Jai Singh's Instruments designed and built a grand observatory at the hub of the city. The instruments are constructed of brick and mortar and are, in fact, very large. Sundials, transit instruments, and giant quadrants were all used to produce observations as accurate as any in the world.

Many other Indian astronomers have followed in the tradition of Sawai Jai Singh, and have made significant contributions to our present understanding of the cosmos. The

Chandrasekhar long list includes Nobel prize winner S. Chandrasekhar, who described how matter behaves in the interiors of dying stars and black holes. We find Indian astronomers

Moving Mirror - **Uranus** investigating planets totally unknown to ancient scholars. Greenish Uranus with its shroud of smog, beautiful deep blue Neptune with high white clouds, and tiny, frozen

Zoom - **Neptune** Pluto, are all routinely scrutinized. Today in India and all over the world, we find

Pluto many dedicated astronomers at well equipped observatories, patiently and relentlessly investigating the inner workings of the heavens. And what a universe we have discovered!

Zoom - **Universe** On the very largest scale, we find that the pieces of the universe are expanding (pause) Flying apart, as if propelled by a giant explosion that took place some 14 billion years ago. At this distant time in the past, all matter would have been compressed into an incredibly small space, sometimes referred to as a "cosmic," or "primordial," egg.

Big Bang Effect Since that initial explosion, the "Big Bang," our visible universe has been expanding, growing, and cooling. Our tiny sun centered solar system is a relatively recent addition

Rotating Galaxy to the universe, and we reside in the outer suburbs of a very average galaxy, surrounded by billions of very average stars, and located in a rather average section of the heavens.

There is, of course, much that we don't know, and perhaps some things are impossible to detect from Earth. But astronomers everywhere are working hard to obtain key observations necessary to understand the cosmos, including its ultimate fate. For the Hindu, the fate of the universe is directly linked with the great god Siva, the same god

Siva as Friend

that swallowed the poison as the sea of milk was churned. Siva can be a friend to all beings, and as such, he is the god of dance, song and music. But Siva is the absolute

Siva as God of Evil

impersonal god, and deals out tragedy as easily as he deals kindness. Siva is also the chief of evil spirits and phantoms of the night; as such, he is often worshiped by thieves and beggars. Combining all the powers of Siva, the Hindu believe that the universe

Dancing Siva

will end when Siva dances Nadanta, the "dance of destruction." As the dance becomes more and more frenzied, the end approaches nearer and nearer. And then, at the end of the dance, the universe is dissolved.

Fade Stars with All-Sky Galaxy

Narrator 3: But what of the real Universe? We may never know for certain, but we cannot help but wonder if the observed expansion will continue forever, or if one day the collective gravity of all matter in the universe will cause the expansion to stop. If the expansion stops, then all matter will begin to fall in upon itself. Planets, stars, galaxies,

Crossfade Stars On with All-Sky Galaxy

everything that exists, will collapse into an ever condensing fireball. There will be no dark night sky, temperatures throughout the universe will soar, and our seared universe will be devoid of life as we know it. Finally, after an amount of time equal to that of the original expansion, matter will be absorbed into itself. Everything will again be contained in a tiny cosmic egg. And perhaps, in the very distant future, another complete universe will rebound from this unimaginably dense cosmic egg, and creation will start anew.

East Horizon

It's hard to avoid a comparison of the real universe with Hindu myths and beliefs, for the duration of each cycle of the universe is roughly that predicted by the ancient Hindu scholars. Coincidence? Almost certainly! But beneath the symbolism are some very serious thoughts about the universe.

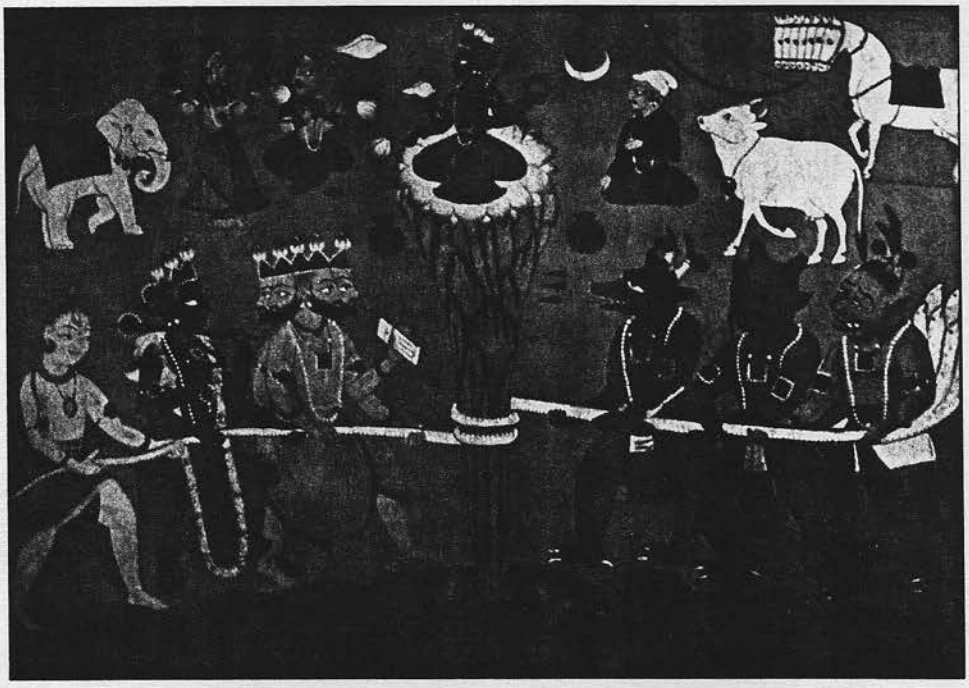
Sunrise Projector

Production note: *During the above, slowly fade the lights and everything from the sky. Then bring in a bit of eastern twilight, and raise the one-wheeled sun chariot out of the east.*

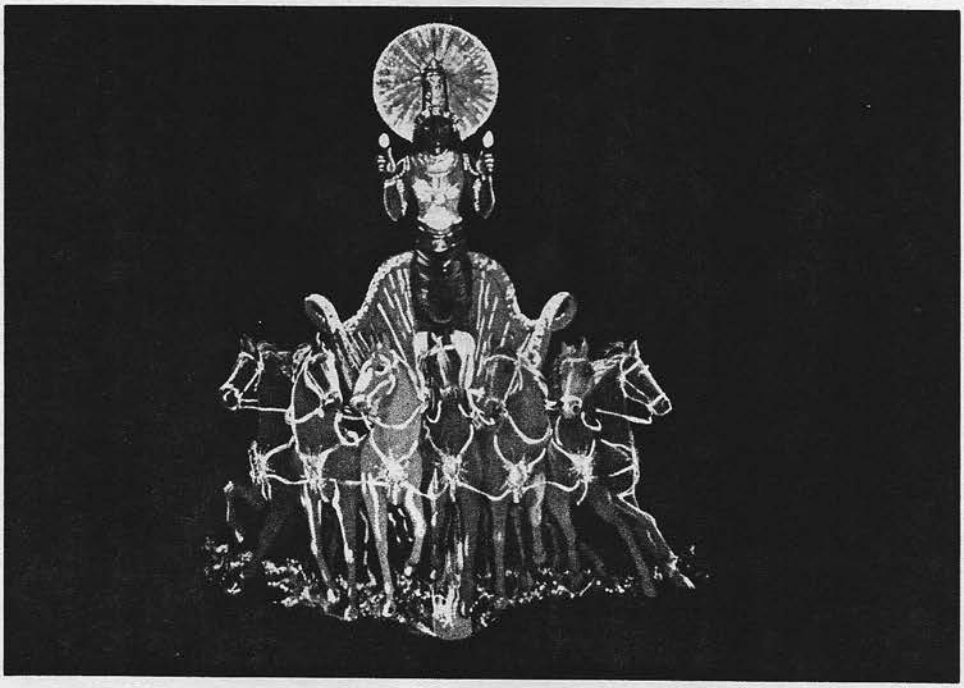
Note from Richard Williamon:

The India production was greatly enhanced by the generous suggestions of my friend and colleague, Dr. P.V. Rao of the Emory University Dept. of Physics. Indeed, Dr. Rao's daughter was the bride in the wedding that the production centered around, and the wedding scenes projected into the planetarium pavilion were from his personal wedding photographs. Moreover, Dr. Rao contacted several Hindu priests on our behalf and obtained chants of specific Vedas (hymns) used during the production.

I also should note that this script is intended to assist you in constructing a presentation on Hindu mythology and their interpretation of the sky. Their use of the lunar nodes (the positions of Rahu and Ketu) to predict eclipses is ingenious and quite straightforward. I hope that you will find the subject as fascinating and compelling as we here at Fernbank.



Churning the Ocean of Milk



The Sun

Ketu

purpose of introducing right ascension and declination is simply to provide a "tool" by which one can find objects by way of an equatorially-mounted telescope.

Why should a novice astronomer be using such an instrument anyway? We all know that the best way for beginners to view the sky is with the naked eye. Usually, the next suggested step is to graduate to a pair of binoculars. Only after mastering star-hopping techniques should most observers move on to using a simple altitude-azimuth-mount telescope. Trying to use an equatorial scope can be not only confusing, but disastrous when it comes to maintaining the interest of the novice in observing the sky. The advent and enormous popularity of the Dobsonian design serves as testament to the logic of keeping things simple for the beginner.

Therefore, requiring the early concentration on coordinate systems seems to me to represent a prime example of what's wrong with education today. Some may contend that the educational system fails to set high enough standards. I think it is more accurate to say that it too often fails to motivate students precisely because of an arbitrarily and unrealistically high standard, set without regard to the intellectual and emotional development of the student. Perhaps as in early childhood education, more emphasis should be placed in high school and college instruction on the principles of psychology and development as relates to the learning process. While some may balk at such a suggestion, it seems more than reasonable to me that not enough attention is paid to the nuances of motivation as relates to adolescents and adults.

A good example of this revolves around the public perception of the space program during the 1960's and early '70's. During this period NASA had a prime opportunity to reinforce public support for future programs during the Apollo moon landings. After all, there was extremely high interest in the space program at that time. But time after time, as the networks called the space agency for on-air experts to provide commentary on moon-flight activities, NASA paraded a series of academic-types into the TV studios who spouted seemingly endless chains of acronyms and technical terms sure to alienate all but the most technically-minded viewers. Historians would later cite this as a major reason behind the waning public support of NASA after the moon landings.

On the other hand, Carl Sagan's "household name" status is surely due to his uncanny ability to popularize science and relate science concepts to the general public. There is little wonder why he became one of the more popular and frequently-seen guests on the Carson show. Despite any criticisms that can be leveled at him (and there are a number), Sagan has proven that "billions and billions" somehow has a more intriguing quality than "1.564×10^{11}."

But what is it that drives such a tendency toward over-intellectualizing basic science courses and curricula? My personal view is that it revolves around three fundamental institutions: politics, bureaucracy, and poor memory. Education administrators apparently think that it is more politically impressive to load down the science curriculum with science concepts which are incomprehensible to the average politician. In doing so, Senator Les Apt is certain to say, "Folks you're really teachin' those kids somethin'. That stuff's so advanced, it goes rite over my head."

Also, since bureaucracies tend to be self-perpetuating and ever-invasive, it has become the trend of late to usurp the decision-making, and stifle the creativity of the individual classroom teacher by layering-on more and more administrative directives and curriculum guidelines from the central authority. I firmly believe that most of this red-tape is generated by people who have either never set foot in the classroom, or couldn't survive long if they did. After all, why do we hire supposedly qualified teachers in the first place? And why do we require them to periodically take courses for re-certification? Must we turn professional educators into mindless drones that merely follow the mandate of some paper-pushing administrator who, for the most part, remains divorced from the daily classroom instructional experience? Perhaps it should be a requirement that all administrators be peer-evaluated classroom teachers as well.

Finally, some educators, including planetarians, seem to have difficulty remembering what it was like when they were students. Often the process of educating someone tends to "intellectualize" them, making it more difficult for them to relate to their students. I wonder whether there should be a mandatory course for teachers, college professors and administrators entitled, "Saganizing the Intellectual." Such a course could go a long way toward improving the educational system in this country.

It is important for science educators to occasionally step back and analyze what it was that got them motivated in science in the first place. Maybe the MTV and Ninja Turtle junkies haven't really given up on learning after all. Perhaps, in our headlong pursuit of intellectual performance, we've just lost our collective way in motivating them to learn science.

Automation Methods For Planetariums
- or -
How Does My Slide Projector Know What To Do Next?
by Jon Frantz

Over the years one of subjects that has fueled many discussions among planetarians has been that of automation. Is it the savior of planetariums as we try to compete with the visual complexity of television and motion pictures to satisfy the increasing expectations of our patronage, or is it evil in disguise as our educational message is lost in a resulting morass of flash'n'trash?

I will leave that topic for debate in scholarly forums or discussion in hospitality suites. The fact is that automatic control systems play an important role in many planetariums today. And with technological advancements driving costs down while increasing capabilities, more facilities will be turning towards these systems in the future to replace aging controls and to help them increase their capabilities and productivity.

One of the most important and least understood details of automatic control systems is that of the methods involved in synchronizing the visual stimuli provided by the projection devices with the aural stimuli provided by a prerecorded soundtrack. The purpose of this article is to examine the most common techniques that are utilized to perform this function. Understanding the strengths and weaknesses of each method is crucial in making a wise choice in selecting a control system that will satisfy present and future needs.

Before we begin our comparison, we need to share some background information along with a few definitions. As we have implied, our discussion will focus on controlling devices in synchronization with a prerecorded soundtrack. Automatic control systems require the use of one or more of the soundtrack tape channels to store information. What exactly is stored, and the ramifications thereof, varies widely from method to method, as we will see. Most methods involve using a computer to create a list of instructions that will tell the equipment what to do, and what order in which to do it, during the show. This can be called scripting. The action of executing one or more of theses instructions at the appropriate point in the show is called cuing. Programming a show is the act of teaching the system to cue the instruction script automatically, under control of the data on the sound track. Once you are comfortable with the preceding concepts, we can begin our comparisons. Note that for our examples we will assume that both the soundtrack and the show instruction script are complete.

Pulse Tones - or - Things That Go Beep In the Night

The most primitive method of providing a link between what is seen and what is heard is that of the infamous beep, or pulse tone. This tone can tell the control system to 'Do Something Now'. Usually, this tone tells the system to cue the next batch of instructions. The important fact to note about pulse tones is that they are all the same. That is, they do not contain information about what is to happen, just that something is to occur.

Show programming is a fairly simple task, as the programmer listens to the sound track and pushes a button to record beeps on the tape at the appropriate locations. Editing an instruction in the script is fairly easy also, as

the script exists as an editable computer file. However, editing the time at which an instruction occurs means moving the pulse tone on the tape, forcing the programmer to erase and re-record a section of the data track. This can be trouble because a mistake with the tape deck can erase good pulse tones or even part of the soundtrack!

Care must be taken before show playback to insure that the soundtrack tape and the instruction script in the computer start at the beginning. Once playback begins, the computer will perform the next batch of instructions in the script whenever the next beep is issued from the soundtrack. If the computer gets out of step with the tape due to tape dropouts or electrical noise, the situation must be observed and corrected manually. Otherwise, all controlled devices will be out of synchronization for the remainder of the presentation.

Instructions

The next logical step from pulse tones is that of instructions. That is, instead of recording a nondescript pulse tone at the time at which an instruction is to occur, record the instruction!

Once again, show programming is a fairly simple task, as the programmer listens to the sound track and pushes a button to record data on the tape at the appropriate locations. But now editing an instruction and the time at which it occurs means editing the data on the tape, forcing the programmer to erase and re-record a section of the data track. As in the previous example, this can be troublesome.

Care must be taken before show playback to insure that the soundtrack tape and the playback equipment start at the beginning. Once playback begins, the playback equipment will perform the instructions as they are played back from the soundtrack. And again, if the playback equipment misses data due to tape dropouts or electrical noise, the situation must be observed and corrected manually. In this scenario, only equipment addressed by the errant data will be affected. The other devices will maintain their synchronization.

Status

Instead of recording data on the soundtrack corresponding to instructions, record the status of all devices continuously! This can solve a lot of problems due to the fact that the playback equipment always knows where devices should be at any point in time. Unfortunately, due to the limitations of magnetic tape, a certain amount of time must be spent recording the status of each device individually. As the number of devices grows, the time lag between device updates becomes noticeable.

It is also important to note the difference between absolute status and relative status. This can be explained most clearly through the use of examples. A section of absolute status data may contain the information equivalent of "slide projector 7 should be on slide #38 and its lamp is increasing in brightness". Obviously, the information necessary to adjust the status of the projector is present in one sample of data. Conversely, relative status data may relay the same information as follows: "The projector that is identified as one more than the last projector has just had its tray forwarded and its' lamp intensity is now ramping in the other direction." This sample of data requires a detailed knowledge of this projector's history to perform a status correction accurately.

Show programming shares the same problems and pitfalls of automating with instructions. It is during show playback that important differences appear. With systems that store absolute data, the soundtrack can be started at any point in the show, and the playback equipment will automatically correct the status of the devices to the correct point in the soundtrack. If the playback equipment misses data due to tape dropouts or electrical noise, the situation will be self correcting. Compare that with systems that store relative data on the soundtrack. They are in little better position to handle faults than those that utilize pulse tones or instructions.

Elapsed Time Programming

Instead of recording pulse tones, instructions, or projector status data on the soundtrack, suppose we record the data equivalent of a

clock, or, more accurately, a stopwatch. The start of the presentation would then be identified as time zero, with the show time incrementing as the soundtrack plays. This technique is called programming with time code.

Using time code, your instruction script contains not only projector instructions, but also the show times at which the instructions are to be performed. Show editing is greatly simplified, because now you can edit a computer file to change not only what happens, but when it happens. No tape editing is necessary!

The level of difficulty involved in show programming will vary with the control system. The advanced systems make it easy by allowing the programmer to place 'unknown' time markers in the instruction list in place of the time values. The sound track is then played with the programmer listening to the audio and the computer listening to the time code. At the appropriate places in the show, the programmer presses a button, and the computer will capture that time and insert it into the instruction list. If the programmer is not satisfied with the time, the time value can be easily edited in the instruction list.

The utilization of time code can also be an asset during normal show playback. The obvious use for the time code is to allow it to cue the instructions as the sound track is played. The more advanced systems can also utilize the time code to give it 'random access' capabilities. That is, the soundtrack can be started at any point, and the computer will scan the entire list of instructions and then calculate and correct the status of all devices. This capability allows for the playback of selected show segments, enables quick recovery from mid-show power failures, and speeds on-line show editing.

Many types of time code are used for synchronization purposes, however the vast majority of applications use the type standardized by the Society of Motion Picture and Television Engineers in 1969. Today it is commonly referred to simply as SMPTE time code.

Compatibility Issues

In general, pulse tones, instructions, and status data are unique for each control system. If it becomes desirable to utilize automated equipment from multiple manufacturers, at least one soundtrack channel must be reserved for each separate system to handle these different formats. On the other hand, since most control systems can now handle SMPTE time code synchronization, each system can share a single SMPTE channel, thus freeing the audio tracks for other uses.

Conclusion

An understanding of the details involved in synchronizing the audio and visual aspects of a presentation leads to the following conclusion. SMPTE time code is clearly the most powerful, flexible, and compatible method of automating a planetarium presentation today and into the foreseeable future.

This table is a summary of the attributes of each of the synchronization methods.

	Pulse Tones	Stored Instructions	Absolute Status	Time Code
Show Programming(1)	Good	Good	Good	Good
Show Editing	Fair	Poor	Poor	Excel.
Tape Edits Required	Maybe	Yes	Yes	No
Playback Accuracy	Fair	Good	Excel.	Excel.
Fault Tolerance	Poor	Poor	Excel.	Excel.
Error Correction	No	No	Poss(2)	Poss(2)
Random Access	No	No	Poss(2)	Poss(2)
Compatibility(3)	Poor	None	None	Excel.

Notes:
(1) The relative ease at which a show may be programmed is more a function of the system than the method of synchronization.
(2) Individual control system specifications must be examined to determine the degree to which an attribute is supported. For example, Control System A and Control System B are both advertised with SMPTE time code capability. A study of specifications may show that System A uses the time code only to step through the presentation, while System B also supports a 'random access' capability.

(3) Refers to synchronization compatibility between manufacturers.

LONGER LASTING LIGHT BULB FOR EKTAGRAPHIC PROJECTORS

by Mike Ryan

Those of you who know about my small theater probably remember the archaic (albeit effective) way I cut down on the intensity of projected slide images on the dome. Sixteen years ago I discovered that a single slide projected full intensity from a throw distance of about 24 feet would effectively obliterate every single star from the sky!

Initially in DBA (the Days Before Automation), the problem was solved with manual household dimmers. Then came computerized control systems (DAA).

Now, I suppose I could control bulb intensity by entering a freeze cue into the program mid-way through a fade-up. However, that requires one more cue for each slide. With normally over 400 cues to a show, I could not justify doubling the instructions (and my programming time) just to hold down image intensity. Besides, if I did that, I would make each of image color slightly warmer since I did not allow the bulbs to reach their peak color temperature.

The answer was easy. mask the front of the focusing lens with black construction paper which has a small cut-out about 15 cm. in diameter. The diagram at the top of the next column illustrates the technique.

When Kodak abandoned the eII projectors in favor of the newer IIIe's, the bulb also changed. Most of us are now using an EXY, 82v., 250 watt bulb.

With the relatively short life span of the EXY, many theaters (those that can afford to do so), replace all their Ektagraphic bulbs after a run of a show. This is their insurance that a bulb will not burn out in the middle of a presentation. Yes, it works, although the practice can get to be a bit expensive.

Last year while browsing through a Sylvania projection bulb catalog, I came across a substitute bulb. The EZE bulb is 82v. but rated at a lower 150 watts with an estimated life span of (and this is important) 150 hours. At the start of the 90-91 school year I installed one EZE in each of the five Ektagraphics I use. With an average of two shows a day for 36 weeks, NOT ONE BULB BURNED OUT DURING THE ENTIRE YEAR!!!

An unnamed planetarium technician told me that I couldn't do this since the bell housings were not the same. *Aux contraire*! I challenge anyone to put the two bulbs side by side. The shape and size is identical.

I hope this helps some other theaters. Incidentally, I am still using the masks. Even 150 watts can blow away the stars. Perhaps theaters with 30 and 40 ft. domes might be able to use the EZE without masks. You might consider buying one to try it out. If you have success, let me know.

FIELD OF REVIEW

Five Billion Vodka Bottles to the Moon
by Iosif Shklovsky
translated and adapted by Mary Fleming Zirin and Harold Zirin
W.W. Norton and Company, New York, 1991
ISBN 0-393-02990-5
268 pages
Hardback
$19.95

Reviewed by Dave Hostetter
Lafayette Planetarium

In a way, Five Billion Vodka Bottles to the Moon was a disappointment. When I first picked it up I expected it to be about the Soviet space program, hopefully with newly available information about their moon program of the 1960s. Instead, what I found was the inside story of a prominent Soviet astronomer's career, namely that of Iosif Shklovsky himself (the title refers to Shklovsky's estimate that the bottles containing the USSR's yearly vodka consumption, placed side by side, would reach the moon). I didn't stay disappointed for long.

Shklovsky might be best known to planetarians for his work with SETI and his notorious suggestion that the moons of Mars might be hollow. I was certainly surprised to see the breadth of his work, though, which I probably should have anticipated considering the lack of information Americans have about Soviet scientists in general.

The book is divided into 24 chapters in roughly chronological order, and provide a fascinating look behind the scenes of Soviet science and society. Some parts are nearly impossible for Americans to comprehend fully, such as the evacuation of Moscow University in 1941 as German armies approached the city. Many of the others are more light-hearted, revealing Shklovsky's sense of humor (which ranges from the delightful to the bizarre) as he discusses subjects ranging from scientific conferences to the Soviet bureaucracy to Stalin's "cult of personality." Each chapter is based on the late Shklovsky's own manuscripts, apparently written from 1981 to 1984, and then hidden away until recently.

This is an interesting and entertaining look at a part of science we don't often see, perhaps even more fascinating now as the Soviet Union goes through its changes. It's well worth reading.

Merlin's Tour of the Universe
by Neil de Grasse Tyson
Columbia University Press, New York
Copyright 1989 300 pages
ISBN 0-231-06924-3
QB52.T97

Reviewed by Kris McCall
Sudekum Planetarium

If you spend time answering public inquiries (and even if you don't) most people will find this little book both useful and enjoyable. It consists of questions that were sent to the McDonald Observatory of the University of Texas at Austin where Merlin answers them in the column he writes for StarDate magazine.

According to the introduction, Merlin is a student of science from Omniscia, fourth planet of the star DRAZIW somewhere in the Andromeda galaxy. (For those who didn't already notice DRAZIW is WIZARD spelled backwards.) He just happened to be born at the same time that our own solar system was being formed from a nondescript cloud of gas and dust. As he grew older he became fascinated with the citizens of Earth, many of whom he noticed had questions about the Universe but knew not where to find the answers. To Merlin, "sharing knowledge and wisdom is as fundamental as acquiring knowledge and wisdom." And it is his wish to fulfill not only ours but also his own curiosity about the cosmos.

One person who wrote in wanted to know the names of the full moons throughout the year. Merlin's answer briefly recounts the agricultural origins of all of them, from honey to harvest and those in between. He also suggests a more hip, revised list that includes among others the Super Bowl Moon, Muggers Night Moon, and my favorite for April, the Tax Return Moon if it occurs before the 15th or the Late Fee Moon if it falls in the latter half of the month.

There is a wonderful little poem to help one reader recall the number of moons in the solar system.

Poor Mercury has no moon,
And Venus does not, it's true.
Yet Earth, of course, has one, while
Planet Mars, take note, has two.

Mighty Jupiter, by jove,
Has its sixteen moons in thrall.
But Saturn sets the record
With seventeen - large and small.

Uranus has quite a few
With fifteen moons, to be sure.
Pluto's one, and Neptune's two
Bring the count to fifty-four.

Obviously it was written before August 1989, but it could be easily updated.

But Saturn sets the record
With eighteen - large and small.
Uranus carries its own weight
With fifteen moons for fun.
Add one for Pluto, and Neptune's eight
Brings the count to sixty-one.

Everyone wants to know "How hot is the sun?" Merlin answers this query quite succinctly giving 18,000,000°F for the surface, and 4,000,000°F for the corona. My only concern here is that I have seen other values in other places and so am uncertain as to the accuracy of these numbers.

"Is there a chance that another star will one day collide with the sun?" According to Merlin, "If there were just forty-eight bumble bees randomly buzzing throughout the United States, then it is more likely that two of them will accidentally bump into each other than it is for another star to collide with the sun." I plan to use that the next time someone asks me the same question.

There are also more difficult questions and answers on topics ranging from Einstein's theory of relativity and the "twin paradox" to the naming of asteroids and an explanation of the Julian Period.

In addition to the glossary and bibliography there are thirteen chapters with titles such as "MOON from werewolves to blue moons," "SUN always a hot topic," "GRAVITY weighty questions from all over," and "BLACK HOLES, QUASARS, AND THE UNIVERSE two out of three are to be avoided." The illustrations are plentiful and humorous making this a well-rounded book for anyone remotely interested in astronomy. It doesn't attempt to be a complete tutorial. Merlin merely seeks to answer those cosmic questions asked by the curious about our vast, beautiful, and mysterious Universe.

Lonely Hearts of the Cosmos: The Scientific Question for the Secret of the Universe
by Dennis Overbye
Harper Collins
438 pp. $25

Reviewed by Jack K. Fletcher
Hummel Planetarium

Cosmology is the study of the origin, evolution and ultimate fate of the universe. It is a subject that humankind has pondered since the beginning of time, but few have ever really attempted to study and understand it. The book presents a fascinating summary of the development of cosmology in terms that a layman will have no difficulty understanding. But it is actually more about the people who have created the field. There is enjoyment in seeing how these personalities interact. Dennis Overbye, an award-winning science journalist, follows the career of Allan Sandage, and in doing so, follows the history of modern cosmology. Throughout his career, Sandage came into contact with all of the people who have influenced the field.

The reader sees that cosmologists are really normal people like you and me. They bicker and fight among themselves just as people bicker and fight in any job. This is illustrated in Sandage's discovery of an unusual star. He was having no luck in deciphering what it was. He asked a friend, Maarten Schmidt, to look at the problem. Schmidt talked to Jesse Greenstein about the problem. Greenstein solved the mystery and immediately published his findings, thereby getting the credit for Sandage's discovery. Greenstein had been one of Sandage's professors. Sandage thought so much of Greenstein that he had a picture on him on his office door. After Greenstein's paper was published, Sandage stopped speaking to Greenstein, and Greenstein's picture hung on Sandage's door, in shreds.

Cosmology has two basic questions. How fast is the universe expanding? How fast is the expansion slowing down? The answers provoke more questions. Will the universe expand forever; will it slow to a stop and remain there; or will it slow to a stop and then fall back in on itself only to cause another "big bang" and thereby start a new universe? The answers will tell us the ultimate fate of the universe.

The book portrays the struggle between the two factions of cosmology trying to answer these questions: the astronomers and experimentalists who believe the answer lies in examining the sky, and the theoretical physicists and mathematical geometers who believe the answer lies in theory. Photographs of the cosmologists enhance the story. There is also an excellent epilogue that brings the reader up-to-date on the people mentioned.

This is excellent reading for anyone who ever wondered where the universe came from and where it is going. Once you begin, it is hard to put down.

ECLIPSE

by James E. Summers
Fulton Planetarium
Atlanta, Georgia

I don't remember studying eclipses in school. Maybe it didn't make much of an impression; maybe it was not part of the curriculum; or maybe there were not eclipses way back then. In any event, I must have learned the basics because I understood what was going on in Mark Twain's A Connecticut Yankee in King Arthur's Court without further explanation.

My next encounter with a solar eclipse was on Prince Edward Island, Canada. An Atlanta-based travel club with their own airplane scheduled a trip for their members to observe the total eclipse in 1971. The eclipse proved to be less popular than expected. Rather than fly a partially empty plane, astronomy staff members from Fernbank were invited along in exchange for pre-eclipse lectures and assistance observing the eclipse.

From the high latitude of Prince Edward Island, totality was short. I don't remember exactly how long it lasted clocktime, but the Canadians had met the challenge of the eclipse with a show of their own, a piper (bag, that is) in full regalia, including kilt. By careful coordination, totality lasted exactly one verse of Amazing Grace.

That eclipse taught me two important things. One, I will never make a living as a photographer of eclipses, and two, I want an amateur Scottish bagpiper (amateur piper, that is, amateur Scotsman is an oxymoron) play Amazing Grace at my funeral. After all, that's probably the only thing that will bring a tear to anyone's eye(s).

My next major solar eclipse was the famous Southeastern Annular of eighty and four. By clever scheduling, the moon's shadow passed through Atlanta during the noon news show and I was chosen to do play-by-play for one of the local stations. I got to catch glimpses of the eclipse during commercials. Fortunately there was no place for my camera on the temporary set on the helicopter pad atop the station building. The magic of shadow bands transformed Atlanta's treetops into a rippling ocean of motion. I almost got seasick.

With that background, you can imagine my anticipation of my trip to Mexico for the "Greatest Eclipse of the Century." No television stations. No bagpipers. Only a week's vacation in one of the most popular tourist areas on the Pacific coast. Good food, good friends, and a great eclipse. What more could anyone ask?

How about clear skies? For the first couple of days we watched local animals lining up two by two up at the cruise boat dock. Then the clouds broke and we saw the sun. At least the leading actor was on stage.

The day of the eclipse dawned partly cloudy and hot. Half asleep and hunger (the hotel restaurant was not open that early) we boarded our buses for the trip up the coast from Puerta Villarta to San Blas. Our departure was delayed when we thought the bus had died. Fortunately it was only the air conditioning. So with open windows, our trip began. A couple of blocks later it almost came to a tragic end when Dave Menke's equipment duffel bag slipped from the over-the-seat rack and hit the driver up side the head. Luckily, Mexican bus drivers are made of sturdy stuff and he shook off a deadly blow with only slight acknowledgement.

About a hundred miles later we discovered what made the driver so tough and impervious to injury - driving on Mexican highways. Our arrival in San Blas was greeted with mostly clear skies, a gentle breeze off the ocean, and a local version of McDonalds. Well actually, it wasn't much like McDonalds. It was some tables and chairs under thatched shelter on the beach with local vendors selling soft drinks, beer and seafood. A pleasant place to wait for the the on-rushing shadow.

Everyone has heard that total eclipses have been observed to fool birds and other low intelligence creatures into believing that the sun has set. It will also fool the weather. As the sky darkened, late afternoon thunder-clouds began to form and rise higher in the sky, including one that moved threateningly close to the disappearing sun.

Were we going to see totality or not? Panic ran through the crowd. We searched in vain for a virgin to sacrifice. As it turned out,

nature is not only fickle, but also malicious. The cloud cooperated until totality. Just as the sun disappeared, cirrus blowing off the top of the thundercloud began to obscure our view. But the observers had the last laugh. Everyone was so excited that we scarcely noticed the intervening mist. With third contact the sun disappeared behind the tower of cloud and did not reappear until just before the eclipse ended.

Once again I demonstrated that when it comes to photographing solar eclipses, I will do well to leave it to George Fleenor, Charles Ferguson and his brother Ken, and to almost everyone else who observed the event. On the other hand, I discovered that this might not be due to a lack of ability on my part, but a subconscious acknowledgement of another priority.

Reflecting on the eclipse after the event, I discovered that instead of taking pictures as diligently as I might have done, I interrupted that project to let people look through the telescope and to explain to them what they were seeing. I remember one wide-eyed little girl, about three years old, who spoke no English, but who listened politely as I spoke to her father, whose English was infinitely better than my Spanish. Once a teacher, always a teacher, I guess.

Maybe during my next eclipse I will get some good pictures. But I will probably not have as much fun.

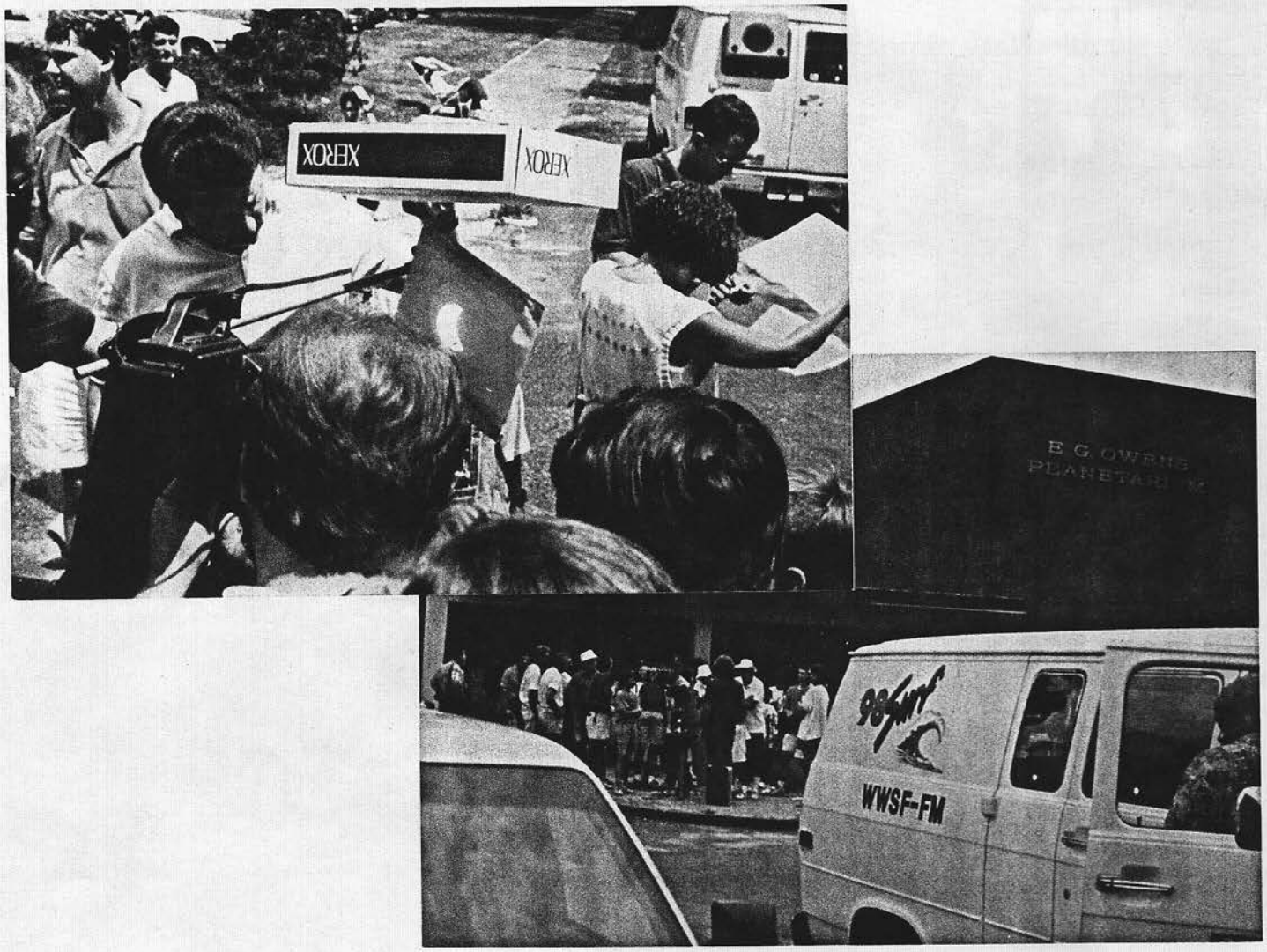
ECLIPSE WATCH IN PENSACOLA

by Frank Palma
Owens Planetarium
Pensacola, Florida

Pre-eclipse media coverage attracted a crowd of approximately 300 spectators to the Owens Planetarium at Pensacola Junior College on the afternoon of July 11. Local PBS station WSRE provided video projection of live coverage of the total eclipse from Mexico via satellite feed. Commercial TV coverage was carried by our local weather reporter, and a Fort Walton Beach, FL FM radio station did a remote broadcast from the Planetarium parking lot. The local paper ran a feature story with pictures the following day. The amount of publicity the planetarium received was entirely out of proportion to the small amount of effort we expended. Thank goodness the Russian coup did't occur on July 11!

Members of the Escambia Amateur Astronomers Association sold mylar solar filters and helped man a half-dozen filtered telescopes. Eyepiece projection, mirror-spot projection, and pinhole projection inside cardboard cartons were demonstrated. For the pinhole box, we used the design suggested by the Pacific Science Center in the June 15, 1991 Newsletter of the Association of Astronomy Educators, page 28. Astronomy club member C.H. Williams dramatically demonstrated the danger of eye damage by setting dry leaves afire at the eyepiece focus of a 6 inch Newtonian.

Meanwhile, my colleague, Wayne Wooten, was in the path of totality near Mazatlan getting some nice video footage that we have incorporated into our fall star shows.



SEPA REGISTRATION June 9 - 13, 1992

Early Registration Deadline - May 22, 1992

NAME: _____

PLANETARIUM: _____

MAILING ADDRESS: _____

_____

_____

PHONE: _____

Early Registration Fee (includes SEPA Banquet)	_____	x $70.00 =	$	_____
Thursday Trip to Mountain	_____	x $10.00 =	$	_____
Late Registration Fee (after 5/22/92)	_____	x $15.00 =	$	_____
1993 SEPA DUES	_____	x $15.00 =	$	_____
		SUBTOTAL:	$	_____

NON-CONFERENCE OPTIONS *for spouse, family members, and etc.*

Tuesday (6/9)	RECEPTION	_____	x $10.00 =	$	_____
Wednesday (6/10)	BAR-B-Q	_____	x $ 8.00 =	$	_____
Thursday (6/11)	LUNCH	_____	x $ 7.00 =	$	_____
Thursday (6/11)	TRIP TO MOUNTAINS	_____	x $10.00 =	$	_____
Friday (6/12)	LUNCH	_____	x $ 5.00 =	$	_____
Friday (6/12)	BANQUET	_____	x $30.00 =	$	_____
Saturday (6/13)	BREAKFAST	_____	x $10.00 =	$	_____
			SUBTOTAL:	$	_____
			GRAND TOTAL:	$	_____

Please check your choice of entree for the banquet:

_____ *Sliced Sirloin of Beef with Mushroom Sauce*

_____ *Grilled Double Chicken Breast with Rosemary*

_____ *Vegetable Primavera*

_____ *I would like vegetarian meals for the whole conference*

Please list any other dietary considerations: _____

_____

_____

Please make checks payable to: ROPER MOUNTAIN SCIENCE CENTER and note SEPA Conference somewhere on the check.