The Planetarian

Vol. 16, No. 1, January 1987

Proceedings of the International Planetarium Society Conference in Tucson, Arizona, July 1986, Part 2

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CORRECTION

The officers of the GLPA and RMPA as printed on page 4 are incorrect. They should read:

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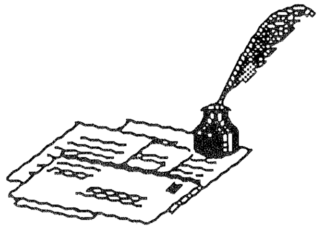
Letters to the Editor



Editor:

This is a plea to all chairmen of conferences and meetings: On the name-tags, make the names big enough to be read from six feet away. This means letters at last one-half inch high, and with a broad pen. Typewriter or ball-point pen won't do.

The main purpose of the name-tag is to promote acquaintance. And the best way to do this is to have our face reinforced by our name every time we meet. At the last two planetarium donferences that I attended, the name-tag was useless except for awarding door prizes.

John Appeldoorn

Editor:

John Mosley's Fall 1986 "Computer Corner" included a review of Parsec Software's*Visible Universe* for IBM computers. As an avid user of *Visible Universe* in our planetarium's instructional program for the past two years, I would like to encourage a two-fold re-evaluation of this software: first, on its own merits in comparison with competitors and second, as a directional signal and warning for the planetarium profession.

Visible Universe provides databases of 17,200 catalogued objects; good planetary and lunar approximation routines; and a modular program design with both layered menus and instant-ciommand keys. The output is visual: (1) zoom in and out; (2) pan in any direction; change time or location; (3) rapidly repeat calculations to show motion; (4) access tabular data; and (5) three choices of viewing mode: (a) a realistic horizon-elevation mode, (b) a planetarium-style mode, and (c) an oval all-sky map in RA-Dec coordinates. In my experience, the program is extraordinarily fast and responsive to users from 3rd grade to professional levels. It allows even the novice user to quickly obtain results once limited to the private domain of professional specialists in astronomy and archaeoastronomy.

Visible Universe has been responsible for significant changes in our instructional programming. A PC lab has almost entirely replaced student use of our projection system. The output of the PCs we are using (Zenith) is video compatible; therefore, "planetarium programs" can now be video-recorded and distributed to classrooms, supplementing (and even in some cases supplanting) bus trips for groups to the planetarium chamber. Most important, the method by which I—and many of my students—get the "feel" of astronomical subjects is now via the PC monitor rather than the projection dome. This change of thought mode—this change of medium—is truly a radical departure.

Some may reject the following statement as heretical, but I contend that it must be seriously considered: With the availability of relatively inexpensive and powerful microcomputers and software, there is little justification for an institution to invest in a vastly more costly (and not so versatile) digital projector; and for the same reason there is no incentive—other than the wrap-around experience of the planetarium chamber—to purchase even a traditional analog projector. With rapidly proliferating graphic capabilities among microcomputers, one can expect soon to see very sophisticated video "planetarium-style," with infinitely greater accuracy and effects than projection could ever acomplish, at a minute fraction of projection costs. Are we ready, or are our heads in the sand.

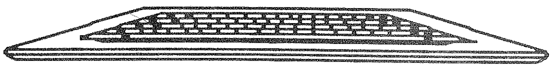
Henry Mitchell
Chatham, Virginia

Editor:

I was startled to read in the script "Time, Space, and Stars," (*Planetarian* Vol. 15, #3, p. 24) that the "Dog Days" occur in November! Had I been laboring under a misconception all these years? Quickly, I flipped open my most important astronomy reference, *Websters Collegiate Dictionary: "dog days n pl [fr their being reckoned from the heliacal rising of the Dog Star (Sirius)] 1: the period between early July and early September when the hot sultry weather of summer usu. occurs in the northern hemisphere 2: a period of stagnation or inactivity"*

Frank Palma
Pensacola, Florida

From the Editor's Keyboard



I'd like to begin by thanking Jordan Marchè, who completed five years of editing *The Planetarian* with the conclusion of volume 15. He's raised the standards of professionalism and appearance of the publication, as you'll quickly see by comparing recent issues with those dating from six or more years ago. He's earned our hearty thanks. I'm pleased to step into a publication that is active and healthy, and I appreciate being able to devote my energies to making something good even better, rather than salvaging someone else's mess. Well done, Jordan! (clap, clap)

Although the production of this magazine is a group effort (it would be 2 pages long without the contributors), the layout and printing of it turns out to be essentially a one-man job, and when that person changes the magazine necessarily changes too. Some of the changes I'll introduce will be because Jordan and I are different people and do things in somewhat different ways; others will be intentional and for a specific purpose; most will be because we have different resources.

My initial goal to is to reduce production costs dramatically by using microcomputer technology while maintaining the general appearance and quality of the magazine. Jordan took the typed text to a commercial printer and they did the rest—typesetting, layout, and printing. The resulting magazine looked great, but we've paid for the service. I produce *The Planetarian* at home on my Macintosh computer, print it on the Griffith Observatory's LaserWriter printer, and have a commercial printer merely print and bind it. The savings are substantial and will go towards longer issues and more frequent special publications.

To be specific, the text for *The Planetarian* is put onto 3.5-inch disks using the Microsoft Word word processing program, illustrations are digitized using a 300 dot-per-inch scanner or redrawn using MacDraw, and the magazine is assembled with the Ready,Set,Go!-3 layout program (which includes a hyphenation routine and spelling checker). The master copy is printed on the Griffith Observatory's Apple LaserWriter printer, and that printout is reproduced and bound at Victory Printing and Graphics. It's ironic, but *The Planetarian* is now being produced with precisely the equipment I recommended to others in the third quarter issue Computer Corner (using equipment that we not yet purchased when that column was written).

The first effect of this modernization has been to eliminate typesetting charges and reduce the net cost of producing *The Planetarian* by well over 50 percent.

The second benefit is to speed up publication from 3 months to 1. I assemble the articles as they arrive, and at publication deadline I send the printout to the printer's. This allows me to put publication dates on each issue. This is Vol. 16, #1; it was assembled in December and printed and mailed in January.

This issue is a first attempt. You'll see improvements in the form of better graphics and typefaces and a more sophisticated layout as time goes on. Your suggestions are most welcome.

Please read the Guidelines on page 8 if you would like to submit material to *The Planetarian*. By following them you can make my life easier and save money for the I. P. S.

I'd like to thank the contributors who have been able to send their articles over the telephone lines or on disk, and would like to encourage others to join the Age of Electronics.

You'll see some additions. There is a new associate editor for **Regional Roundup**—Steve Mitch—and there are four new features. Tim Kuzniar has agreed to prepare a **Kodalith Corner**, where planetarians will find camera-ready artwork they can shoot and use in their shows (certainly a valuable service and an important benefit of membership). His column will begin with the next (April) issue. Please contact him if you have suitable artwork to share. David Menke has begun an important series of columns **Planetarium Lifeline** on the history of both planetariums and planetarians.

I would like to see closer cooperation between the I. P. S. and other professional organizations that share our goal of communicating astronomy to the public. To this end, Andrew Fraknoi, Executive Officer of the Astronomical Society of the Pacific, has graciously agreed to contribute a regular column called **Astronomy Resources**. In it he will acquaint I. P. S. members with activities and publications of the A. S. P. that are of mutual interest and benefit.

I'd also like to see *The Planetarian* used more as a vehicle for dialog on controversial, timely, or important topics. It is the only publication read (or that <u>should</u> be read) by *all* members of the planetarium community around the world, and this is where we should discuss our goals, problems successes and our future. I've initiated the **Forum** (pages 34 and 35). Look for it, and please respond with your own comments. If there is no further dialog it will die an early death. I would also like to encourage people to make more effective use of the **Letters to the Editor** section—where else can you air your gripes before the entire planetarium community for the trivial cost of a postage stamp?

You'll find the address of the authors of each article and feature at the top of the article to make it as easy as possible for you to contact them with your comments.

I also hope to see closer cooperation between U.S. planetariums and planetariums elsewhere on our little globe. It is with disappointment that I report that, of the letters I have sent abroad, not one has been answered. If readers in Europe and elsewhere feel that they are under-represented, it is not my fault; talk to your colleagues. I would like nothing more than to underline the I in I. P. S., but I can hardly do it alone from Los Angeles.

My heart-felt thanks to all who help. ❑

New IPS Officers

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Armagh, Northern Ireland

Executive Secretary
Dr. Gerald Mallon
Norristown, Pennsylvania

(continued from page 53)

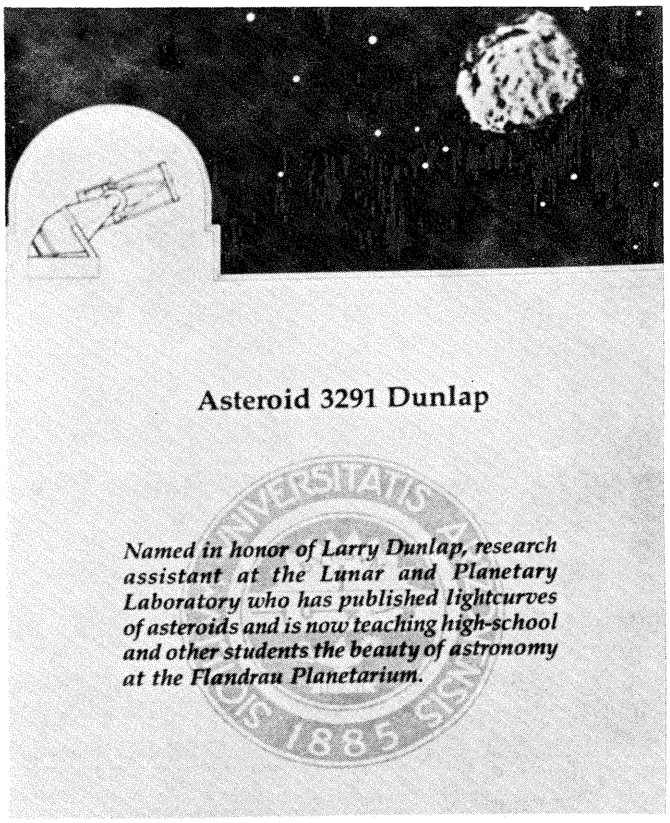
that can choose circuit boards that are operational from those that are not. This robotic arm can put out a fire and toot its own horn. In addition, we have a "people-powered robot" that operates on kid power. We want to demonstrate how the joints in a human arm are similar to the axes of rotation in a robotic arm.

All of the topics we present in our outreach program relate to space science. We want to bring equipment, technique, and expertise (not necessarily in that order) to the rural areas of Utah that might not otherwise benefit from this type of program. Our goal for the outreach program in the future is to increase our student contact hours and our program diversity in a resourceful fashion. ❑

Planetarian Honored With Asteroid

Larry Dunlap, of the Flandrau Planetarium in Tucson, Arizona, was honored in a ceremony on September 24, 1986, when asteroid 3291 was named after him. Larry was the first of many high school teachers who worked for Tom Gehrels at the Lunar and Planetary Laboratory in Tucson during the past twenty years. Their asteroid research has contributed greatly to our understanding of these minor planets. Three other teachers were similarly honored.

The plaque reads: **"Asteroid 3291 Dunlap. Named in honor of Larry Dunlap, research assistant at the Lunar and Planetary Laboratory who has published lightcurves of asteroids and is now teaching high-school and other students the beauty of astronomy at the Flandrau Planetarium."**



Guidelines for Contributors

Articles: *The Planetarian* (ISN 090-3213) welcomes articles on astronomy that would be of interest to planetarium educators. Preference is given to articles that closely relate to the philosophy, history, management, technical aspects, and history of planetariums, and to ideas that can readily be incorporated into planetarium programs.

Text: *The Planetarian* is prepared on a Macintosh computer and LaserWriter printer. Text ultimately needs to be in computer-readable form, and can be submitted in four ways:

1) mailed on a Macintosh disk (most preferable); 800k disks OK;
2) over the telephone lines to CompuServe as electronic mail; send to John Mosley, ID# 74156,473, as unformatted text; end the article with "The End";
3) mailed as unformatted text on an IBM or compatible disk (please strip out control characters); double-sided disks OK;
4) mailed as double-spaced typed or printed copy on paper (please send two copies).

Articles that are sent on disk or through CompuServe should be followed by a printed copy that notes italics, boldface, Greek letters, accent marks, and other formatting instructions and special characters that are lost when transmitting unformatted text.

Illustrations: All illustrations, both line drawings and photographs, should be camera-ready. Photographs should be full size b/w prints, and I will reduce them to fit. Line drawings can be submitted full size or the size that they will appear when printed. Illustrations prepared on a Macintosh computer as paint or draw files should be submitted on disk since that allows the greatest flexibility in sizing them properly. The inclusion of good illustrations is encouraged.

Deadlines: *The Planetarian* is published quarterly and is mailed in January, April, July, and October. The final deadline for all submissions is the solstice or equinox of the month preceding the date of issue.

Address inquiries and submissions to:

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Los Angeles, California 90027
(213) 664-1181

Proceedings of the I. P. S. Conference Tucson, Arizona, July 1986 Part 2

These papers were presented at the International Planetarium Society conference in Tucson, Arizona, in July 1986. Part 1 was published in *The Planetarian*, Vol. 15 #4, last quarter 1986. Papers are printed in alphabetical order by first author.

The Holt Planetarium Video Projection System

George Corrigan and Alan Gould
Lawrence Hall of Science
University of California
Berkeley, California, 94720

The new technologies of video projectors, laser disc players and microcomputers are opening up new realms of opportunity for effects in planetaria. The system in place in the Holt Planetarium at Lawrence Hall of Science includes three main elements: (1) a three-gun video projector (Sony VPH-722Q) aimed about half-way up in the southwest area of our dome, (2) a laser disc player (MCA Disco Vision System PR-7820), and an Apple II+ computer. A switching system allows easy console control for changing modes of graphics. Also, the images displayed from the laser disc player can be controlled by the operator at the Apple II+ by means of an "ALLEN INTERFACE" between the computer and the laser disc player (Allen Interface made by Allen Communications Inc. in Salt Lake City). Figure 1 shows how the components are linked.

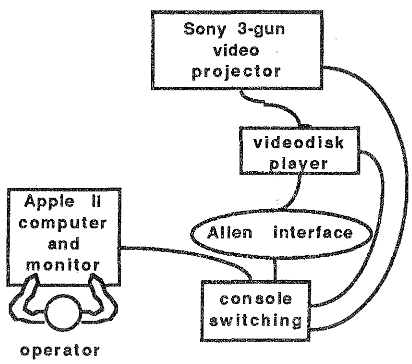

Figure 1

Detail of the console switching arrangement is shown in Figure 2. Switch 1 determines which input (laser disc or computer graphic) is sent to the main video projector for audience viewing. Switch 2 allows automatic control of the laser disc player by the computer keyboard. Switch 3 allows for the image on the dome to be turned off. Switch 4 determines which input (laser disc or computer graphic) is sent to the computer monitor. Switch 6 allows the audio to be turned on or off.

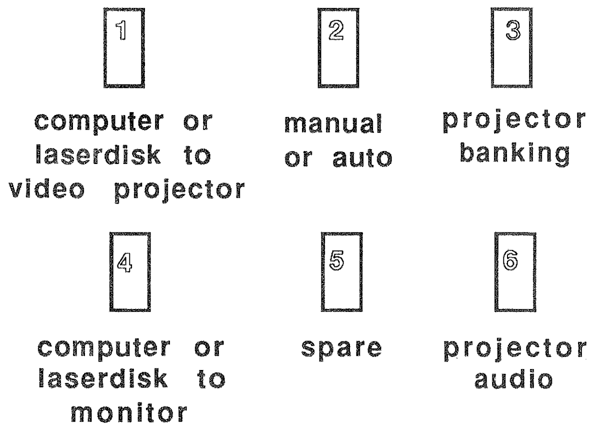

Figure 2

The first use of our system in a planetarium show was in our show *Is Anybody Out There?* It utilized only computer graphic capability. Both major audience participation activities in this program involved interaction with the computer. The first activity consisted of the audience putting in numerical values for factors in the Drake equation to estimate the number of civilizations in our galaxy with whom we might be able to communicate. The computer displays a graphic image of each successive factor in the equation, prompting a numerical value input:

NUMBER OF STARS IN GALAXY	1,000,000,000
PERCENTAGE OF STARS WITH PLANETS	20
PERCENTAGE OF PLANETS SUITABLE FOR LIFE	10
PERCENTAGE OF PLANETS WITH LIFE	1
PERCENTAGE WITH INTELLIGENT LIFE	20
PERCENTAGE THAT CAN COMMUNICATE	30
LIFETIME OF A CIVILIZATION	100

THE NUMBER OF CIVILIZATIONS IN OUR GALAXY FOR US TO COMMUNICATE WITH IS: 8,000,000

The other activity involves the audience attempting to decode a "message" from another civilization received in one of our giant radio telescopes. The message (Figure 3) consists of 5 images and is displayed successively by computer graphic input to the video projector. The images shown below are actually an earlier draft of the message shown in our program. (We eliminated the destruction of a planet.)

The possibilities for creating computer graphic images on the dome are endless, limited only by memory and programming imagination. Ready-made software may be used as well. We plan to purchase Eric Burgess' new comet software to use in our already developed comet program, *Comet of the Ages.* Our use of this new toy is really just beginning.

Use of the laser disc player for displaying video images is facilitated by software written by the author (George Corrigan).

SOFTWARE

The software includes a section called "TITLER" which allows rapid creation of video graphic titles (in words) to project on the planetarium dome. The section of software that facilitates creation and execution of video "scripts" (laser disk and/or computer graphic sequences) is called "VIDMAX." It utilizes the Allen Interface between an Apple II+ computer and the laser disc player.

Figure 4 (next page) shows a "walkthrough" of how the software works from the instant of boot-up. The actual monitor display appears in boxes.

Figure 5 (following page) shows a chart of VIDMAX menus used in creating and executing program "scripts."

In order to display a laser disc video "script" in a planetarium performance, the console operator must first acquire the SCRIPT EXECUTION MENU on the computer and then press "A" on the keyboard. The first sequence automatically runs. At the end of each sequence, one of three "OPTIONS" occurs: (1) NORMAL [N] means that the program segues to the next video sequence, (2) PAUSE [P] means that the program will proceed to the next sequence only when the operator hits a keyboard key (any key), and (3) REJECT [R] occurs when the laser disc needs to be turned over in the middle of a program.

The EDITOR MENU is used to create new scripts or edit old ones. The functions of most of the entries in the EDITOR MENU are evident from their names. One can INSERT, VIEW, EDIT, DELETE, LIST, SUPPRESS, or RESTORE sequences. To make new sequences, the ADD SEQUENCE function is selected. In the sample entry shown on the previous page, SEQUENCE TYPE may be either laser disc video (V) or computer graphic (G); DISPLAY MODE may be at either normal speed (N) or slow speed (S); and the OPTIONS pertain to what happens at the end of each sequence as outlined in the paragraph above.

The PLAYER COMMAND MENU contains mostly standard laser disc player functions and is included in

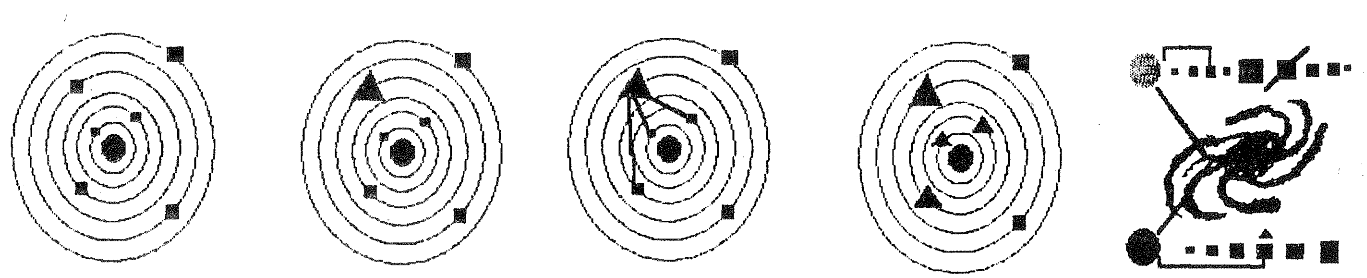

Figure 3

Execute which show?

[Example: operator enters MOONS]

Comments: several show scripts can be contained on one floppy disk. The first three shows that we developed were "IAO" (Is Anybody Out There?, graphics only), "Shuttle" (the Space Shuttle), and "Moons" (moons of the solar system).

Display titles (Y/N)

If operator enters Y, the title "Moons of the Solar System" is projected onto the dome and rotated to align successively along each cardinal direction: N, E, S. W.

If operator enters N, then VIDMAX is loaded and the following menu appears:

Script Execution Menu	
A: Auto Mode	M: Manual Mode
T: Display Titles	E: Editor Menu
C: Change Show	Z: Catalog Disk
Q: quit	

Each menu item is explained in Figure 5.

Figure 4

this software for convenience in viewing laser disc images and obtaining frame numbers for use in creating and editing script sequences. The APPLE (A) and VIDEO (V) entries allow the operator to put either video disc image or Apple contents on the monitor screen.

PROGRAMS

The Holt Planetarium staff have so far produced two shows utilizing video disc "scripts." The first was a Space Shuttle program which contains spectacular NASA footage of a Shuttle launch, a landing at Edwards AFB, space walk activity, launching of satellites, and humorous clips of astronauts "playing with their food." An audience activity used in connection with this show is one in which each audience participant is handed a top which must be balanced on its tip, first without spinning and then with spinning. Of course it's impossible to balance the top on its tip without spinning it. The audience is then shown the video sequence in which an astronaut demonstrates the stability of a spinning gyroscope in zero g environment.

The second planetarium program for which a video script was created was an already developed show entitled *Moons of the Solar System*. This show already contained audience activities in modeling phases of the moon and keeping "Galilean" records of the four largest Jovian moons. The last portion of the program was an imaginary spaceship ride, beginning with a countdown and blastoff, then proceeding with "visits" to moons of Mars, Jupiter, and Saturn via slides of images obtained in the Viking and Voyager missions. It was this spaceship ride portion of the program that has been immensely enhanced by using video disc images. We are able to show a motion picture of a rocket launch following the countdown. More images of moons are accessible from the video disc than were available to us from slides. One of the most exciting additions that was not previously possible for us is the inclusion of the motion picture of Jupiter rotating with moons revolving around it, compiled in timelapse fashion from real spacecraft images.

Of course motion pictures and still images can be incorporated using more conventional instruments: movie projectors and slide projectors. The tremendous advantage of the video projector system is the ease with which motion picture, still images and computer graphic images can be integrated smoothly into a show. The planetarium operator controls all of it from the same compact keyboard and proceeds from one effect to the next either automatically or by hitting any key on the keyboard—easier than operating a complicated console of knobs and switches.

An added plus is the ease with which titles and printed images can be produced. The whole process of making kodalith slides is circumvented by using the TITLER component of this software. Lettering may be formed from a choice of three fonts and two sizes. Printing can be rotationally translated for easy viewing from any direction in the planetarium.

Software for the system may soon be available from Lawrence Hall of Science, University of California, Berkeley. Software will include TITLER and VIDMAX programs as well as specific show "scripts" for *Is Anybody Out There?* and *Moons of the Solar System*. The video discs used are available from Video Vision Associates, Ltd. They have produced several video discs in the area of astronomy and space travel for use in education and in planetaria.

UPDATE: 4/86

The Holt Planetarium recently acquired the Astronomy disc from Video Vision. We have found it to be an extremely rich source of images for augmenting activities in many of our planetarium programs.

A new technique we have found to be particularly effective is panning a series of still images in slow motion. For example, in the program, *Is Anybody Out There?*, near the beginning of the show we discuss how big the universe is in terms of how many galaxies have been observed by large telescopes. For this section we have added a video sequence called "Gallery of the

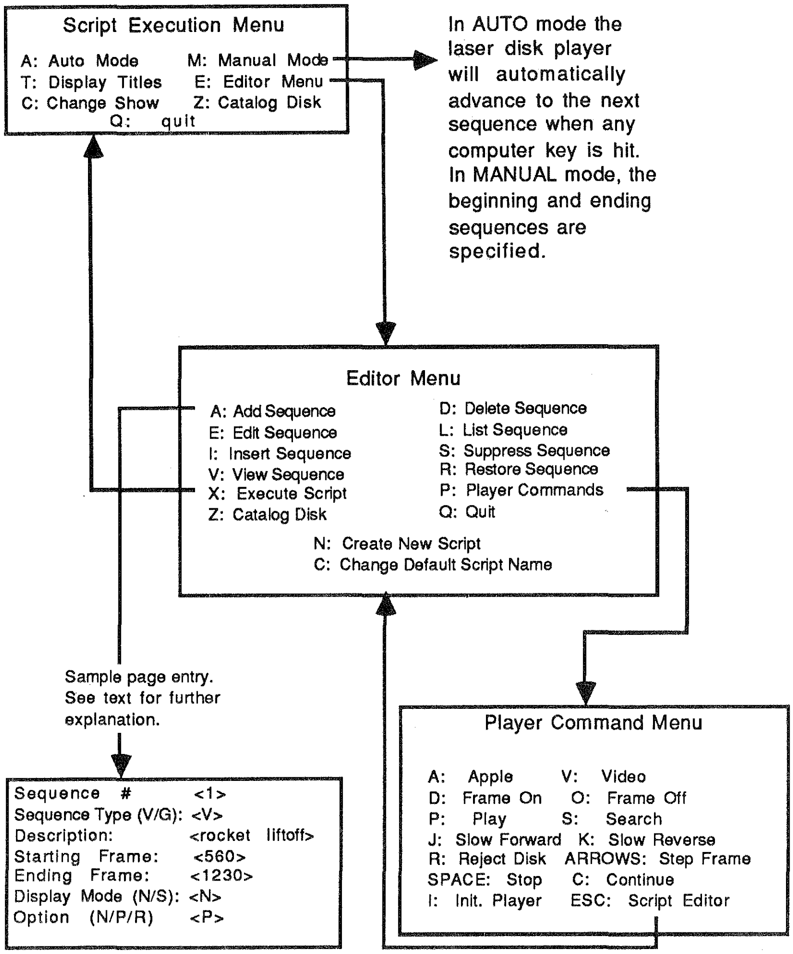

Figure 5

Galaxies" illustrating the diversity of types of galaxies in a slow motion series of still images.

In our *Red Planet Mars* show, one main audience participation activity is for each visitor to pretend to be an astronomer attempting to draw a detailed image of Mars from observations through our "telescope" (a Mars image projector that makes a rippling image of Mars as if viewed through normal atmospheric turbulence). We then show a series of video still images, again in slow motion mode, that directly compare earth telescopic photos of Mars with corresponding astronomers' drawings. The drawings show much more detail than the photos.

Considerable drama has been added to our shows by simple addition of motion picture (normal speed) clips from the Astronomy laser disc. In our *Moons of the Solar System* show, we are able to show the stop action movies compiled from NASA Voyager images showing the rotation of Jupiter, orbiting of moons around Jupiter, Jovian cloud motion and close-up movements of the red spot, a Saturn rotation compilation, and the famous "spokes in the 'B' ring" movie. In our *Red Planet Mars* show we now add the movie of "an airplane ride around Olympus Mons" compiled from Viking orbiter topographic data assembled in a computer simulation. There are even a couple of effects produced by Digistar technology of motion through the stars at "warp" speed contained on the Astronomy laser disc.

Our latest addition is in our show called *Colors and Space.* One of the audience activities involves visitors seeing how filters work by looking at different color lights through various color filters. We now can also show images of the Ring Nebula photographed through different color filters to illustrate actual use of filters with telescopes. Another audience activity involves visitors seeing how stellar and planetary atmosphere composition can be found by observing spectra through diffraction gratings. There are some nice images that we use from the Astronomy disc that illustrate invisible light (UV, X-ray, radio,...), instruments that detect such light (satellites, radio dishes,...) and actual images that those detectors can be made to produce. ❑

Scientific Tools and Techniques in the Planetarium

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Scientific Tools and Techniques, or STT, is an innovative project launched by the Fernbank Science Center. The Center, operated by the DeKalb County School System, draws 60 ninth graders each academic quarter from a population of 5,500 students. These students, selected by grades and teacher and counselor recommendations, spend a quarter at Fernbank studying only science and mathematics.

The students are introduced to 13 scientific disciplines such as anatomy, entomology, electron microscopy, physics, and chemistry. During their 12 weeks of study students are also introduced to astronomy, and through this they have the opportunity to experience the planetarium.

In the planetarium each student is required to produce a mini-planetarium show. To do these shows students learn how to use our research library to accumulate background on their chosen astronomical topics. The students work in teams of 2 or 3 to put these shows together. During the research process students spend time selecting slides to accompany their scripts. In addition, the students learn the use of the console to operate both the planetarium projector and auxiliary special effects projectors.

The results have been quite gratifying. Students were genuinely excited in being able to present their own shows to their peers and it made astronomy a lot of fun for them. It put their creativity to work in finding new ways to present topics such as Mars, asteroids, and stellar evolution.

There were also a few unexpected benefits to the planetarium from the STT program. As the students read their scripts during their presentations, we discovered that several of them had excellent speaking voices. We're always searching from good voices to narrate our children's programs and for occasional parts in our adult programs. Thanks to STT we have a good supply.

The students themselves enjoyed their association so much that they formed their own alumni club. This club sponsored such speakers as astronaut David Lowe and noted author Timothy Ferris. The students assisted the planetarium by providing volunteers to help as ushers during the times of heaviest attendance.

These students have helped us by providing their time and enthusiasm to our annual fund raising festival. They have also passed their enthusiasm on to their parents, and many have joined as museum members. The membership has doubled over the past year.

So our investment in time in using the planetarium for this program has reaped the short term benefits of generating enthusiasm for science and for the science center. It has increased our community support. The long term benefits are not yet known, but perhaps we will see community leaders with a background in and an appreciation of the planetarium and of science, or perhaps future leaders in science who got their initial inspiration at Fernbank. ❑

For Rent—The Universe

Part One: Training the Teachers

Part Two: Administering The Rental Program

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ABSTRACT

To address the needs of astronomy education in the New York metropolitan area, the New York Hall of Science has implemented a unique rental program for Starlab portable planetariums. Classroom teachers from the area are trained in a 4-day workshop on how to use the equipment and how to present lessons in the planetarium. These teachers then schedule the Starlab for rental during the school year and take the planetarium to their schools for use. The program has been extremely successful and very well received.

QUESTION

How can the New York Hall of Science improve science teaching in the Metropolitan area?

OBJECTIVE

Can specialized training help educators move beyond textbooks to observational and activity-based astronomy teaching?

Can specialized rental equipment enhance science teaching in the schools?

How will area school districts and educators respond to the availability of this equipment and training at the New York Hall of Science?

METHOD

Bring together five Starlab portable planetariums, a nationally recognized planetarium educator (Dr. Gerald L. Mallon of the Methacton School District in Pennsylvania) and 81 New York-area classroom teachers for a summer training program at the New York Hall of Science.

Start with two 2-day pilot sessions with area educators in April to evaluate the content and format of the specialized training.

Work with the New York City Board of Education to identify private and public school teachers with science teaching responsibilities at both the elementary and secondary level. Include both science specialists and generalists.

TRAINING

Each participant received an 83-page workshop manual plus two activity guides.

The training sessions were a dynamic mix of demonstrations, sample lessons, small group projects, hands-on activities and lectures and covered:

- Starlab set-up, take down, and maintenance
- Methodology and examples of participatory planetarium lessons
- Hands-on classroom activities such as sundial making, construction of a 3-D model of Big Dipper, creating interstellar messages, etc.
- Observational astronomy: celestial motions, phases of the moon, retrograde motion of planets, annual motion of the sun, constellation recognition, sky map interpretation, apparent stellar magnitudes, comets, etc.
- Special topics: light and the eye, archeo-astronomy, modern cosmology, parallax and stellar distances, etc.

The workshops also included information on the mechanics of renting the equipment, pick-up, costs, etc. and suggestions for sources of funding for the rental. Workshops concluded with a formal evaluation by participants. Their comments were vital in adjusting the program to meet teacher needs. As the workshops progressed, more emphasis was directed toward astronomy background for the participants and less time was allotted for sample teaching methods.

Participants received a letter certifying completion of training and eligibility to rent Starlab for use in their schools.

RESULTS OF TRAINING

	Totals	%
Total number of teachers trained	132	
Summer 1985	96	
Winter/Spring 1986	36	
NYC public school teachers trained	101	78
have since rented Starlab	37	43
Suburbs/private school teachers trained	32	22
have since rented Starlab	20	70
Science teachers	32	22
Classroom teachers	65	44
Other teachers	35	34
Have access to own planetarium systems	24	20

Projections (students served by Starlab in New York metropolitan area)

Sept. 1985–Aug. 1986	30,000
Sept. 1986–Aug. 1987	75,000

A planned Spring (1986) training session has 30 participants. Plans call for an additional 120 teachers to be trained over the summer of 1986.

98% of the teachers reported that the training met or exceeded their expectations.

99% reported that they felt competent to teach basic astronomy principles to their pupils using observational and hands-on activities.

84% reported that they had mastered the Starlab equipment.

TEACHER COMMENTS ON TRAINING SESSIONS

"The Starlab course...was one of the most exciting courses I have ever taken (with 18 years of teaching experience and an MA +90)." Science Specialist, Lynbrook Public Schools.

"This rejuvenated and re-motivated me." Science Cluster Faculty, P.S. 308, Brooklyn.

"I will be able to open my students minds to the wonders of astronomy." Third Grade Teacher, Our Lady of Victory, Floral Park.

"Not only did I gain practical teaching ideas and increase my knowledge of astronomy, but...I met other people willing to share ideas and time." Science teacher, P.S. 308, Brooklyn.

"Many previous explanations of the universe's planetary system...were only 'explanations.' This type of course should be an integral part of the science curriculum offered by the colleges/universities." Science Cluster Faculty, C.E.S. 64, Bronx.

"I entered the Hall of Science with no prior knowledge of astronomy. I left with my head in the stars and my mind brimming with ideas for my classroom." Third Grade Teacher, The Garden School, Jackson Heights.

RENTAL PROCEDURE

After taking part in the training sessions, participants are eligible to rent a complete Starlab from the New York Hall of Science. The renter calls the Hall to see if the equipment will be available on the desired dates, and confirmation forms and regulations are then sent by mail to the renter. Only two sets (of the five) are scheduled to be out at any one time. The renter returns the signed confirmation form with payment as well a release and indemnification. The renter is responsible for secure, safe transport of the equipment, which can be picked up from the Hall on the afternoon prior to the first day of rental. The equipment must be back to the Hall by 5:00 p.m. of the last rental day.

As part of the training program, participants were given use of Starlab for 1 free day. Rental fees for additional days is on a sliding scale, with $75 for a one day rental to $200 for 4 days. Most rentals to date, used school building or district money, but several used funds donated by the Parent Teacher Association or private sources.

TEACHER COMMENTS AFTER RENTAL

"Fabulous—it motivated the students, thrilled parents."

"Everyone included, children, teachers, parents had a very positive reaction."

"We want one!!!"

"Children throughout the school are doing a lot of creative writing as a result (poetry, stories). They were very excited, asked many questions, are doing more work."

"The students were thrilled...and many really took to the sky maps and locating the constellations."

"Very enthusiastic! A parent told me her child wants a telescope on his birthday."

"Hope to have more teachers take the training. Will start an Astronomy Club. Will rent it next year to do more."

"Instead of a one-week rental, we'd like to have Starlab for several weeks."

EVALUATION OF STARLAB PROGRAM

The Starlab program has met with overwhelmingly favorable response. Once teachers and administrators saw Starlab in use, they became staunch supporters and advertisers. Most rentals have been for 1 week, and there were several rentals for two week periods. A frequent comment by renters was the anticipation of renting Starlab for longer time periods during the next year. Once Starlab was in a school environment, it was utilized extensively and in a variety of ways. Most of the rentals have had the entire school population in the Starlab facility at least once. It was the centerpiece for numerous science fairs and open houses, and was used after school by clubs, parent groups and the community on "Astronomy Nights."

This first year of operation for the Starlab program has been a testing year and as such, certain needs for the teacher have become apparent. Follow-up was very important for classroom teachers who were not that comfortable with science content. Starlab was an easy way for them to bring exciting science content into their schools but support from the staff at the Hall was an important factor. About one-third of the renters took advantage of the opportunity to come to the Hall to practice with the equipment and consult with the staff. A number of teachers also wished to confer with the staff about lesson content and structure. Requests were made for more sample lessons that directly supported the required curriculum.

The equipment has been used under a variety of conditions. Starlab has been set up in gyms, classrooms, auditorium stages, and cafeterias. During the rental periods, there was a great volume of people using the equipment. The average number of students through Starlab was 350 per day. Most of the equipment has tolerated this heavy usage fairly well. The dome has accumulated many holes during the rental year, but the Hall has been able to patch them as needed. There have been no problems with the main projector. The flashlight pointer, however, became a problem and it has been necessary to find a replacement for the ones supplied by the company in the original purchase. Teachers using any sort of rental equipment expect it to be "trouble-free." Although extra bulbs and batteries were supplied with each rental, all equipment had to be carefully checked before its next rental. This is a task (bulk maintenance) that most museums would be well organized to do.

The training program has attracted one audience that was not anticipated, those teachers who have their own planetarium facility but do not know how to operate it, or use it effectively for teaching. Twenty percent of those trained so far have access to equipment. Two school districts have purchased the equipment after starting with the rental program from the Hall. There are several participants attending the Spring training sessions who are from out-of-state and thus are taking the training with no plans to use the rental program.

Finally, the Starlab training and rental programs have exceeded the expectations of the Hall. The New York metropolitan area has eagerly responded to this new method of enhancing science teaching in schools. In light of this, the New York Hall of Science plans to continue to expand and support this program in the future.

SUPPORT

The Starlab training program was funded by the He-

brew Technical Institute. Terry Boykie, of the New York Hall of Science, provided major assistance in the preparation of this report. ❑

Skylights, A Planetarium Program Exploring "Nuclear Winter"

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In May, 1986, the North Museum of Franklin & Marshall College premiered an unusual public program—one dealing with the climatic effects of nuclear war ("nuclear winter"). It has been well-received by the community so far during half of its four-month run. Other planetariums may wish to consider similar programs, based upon our experience.

Why discuss nuclear winter in the planetarium? The topic grew out of a desire to produce a weather-related atmospheric astronomy program, using as much of the dome as possible to create a multi-media environment. But while thunderstorms, rainbows, solar halo displays, blue skies/red sunsets and even the aurora borealis can and have been treated well in other planetarium shows, I wanted to go beyond this. I decided to connect the topic of "nuclear winter" to a standard "weather" show and see what the results would be.

The major source of printed information on the subject and a history of its development is the book, *The Cold and the Dark* (Ehrlich, Sagan, et al., 1984). This work summarizes the results presented at a major international conference held in Washington, D.C. in 1983. Their initial computerized simulations have been superseded by more detailed modeling, however, and should be considered a first approximationion only. An organization acting as a clearing-housese for the latest information (including Department of Defense studies) is the Center on the Consequences of Nuclear War. Their staff provided essential help as the program took on its final form.

Given the uneasy nature of the topic, and the simulated destruction of the world that would be necessary, how could we keep it from being a real "downer" with everyone depressed at the end?

The answer was worked out with the help of colleague Francis Downey to (1) emphasize that nuclear war doesn't have to happen; (2) circle back to the beginning of the show, using the rainbow as a continuing symbol of hope; and (3) use the local resources of school children's voices and artwork to represent the potential of future generations. While this may not be the only way of solving this problem, it worked out well for us.

PRODUCTION NOTES—VISUALS

Nine pieces of original artwork were commissioned by the Washington conference committee, and were reprinted in Ehrlich and Sagan. Duplicate slides are available from the Center, although I found the quality to be somewhat lacking in some instances. We were also able to borrow videotapes of the "Moscow Link" made during the conference, and with them shot stills from a high-resolution color monitor. There is also a fine dissolve sequence on the supposed destruction of New York City, accompanying the August, 1984, *Scientificic American*. Finally, we created b&w typographic visuals from data given in the various reports.

One visual effect that we decided against using was a large strobe explosion. Two out of our last three public programs had featured this effect, and it was becoming clichéd. Instead, the sound track was designed to carry off the "end" in audible manner (rumbling, wind and other noises).

While not a show that is heavy in its emphasis on astronomy, it does cover a scientific topic of much current interest and concern in a no-nonsense way. It also makes a social statement that few can argue with.

If planetariums are to continue to attract new (and repeat) audiences, without becoming "stale," then these are some of the challenges we must meet.

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The "La Uilette" Planetarium

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INTRODUCTION

13 March 1986–Giotto, the European probe, encounters Halley's Comet.

13 March 1986—Inauguration of the "Center for Science and Industry." During this great event, the encounter between Halley's Comet and Giotto has been experienced in real time. Contacts have been established with the comet via Darmstadt, Australia, Moscow and Reunion Island.

A great part of the Center for science and Industry is now open. It already receives about 15,000 visitors per day. This Center will be the focal point of the futuristic La Villette complex in northeastern Paris. Located in the city's largest park and crossed by two picturesque canals, the complex was conceived as a stimulating environment and meeting place for the arts, sciences and music. In the future, the complex will also include a large music center. When completed, the park itself will be studded with cafés, restaurants, gardens, sports facilities and the Zénith, a theater for pop and rock concerts (open since 1984).

The center will encompass many activities:

- The "Géode," an Omnimax theater

- Permanent exhibitions organized into four themes:
  *From space to the universe
  *Life adventure
  *Language and communication
  *Matter and man work
- Temporary exhibitions
- Discovery rooms for youngsters, the "Inventorium"
- Scientific actuality rooms
- A "mediatheque" which is a multimedia library
- Scientific clubs
- International Conference Center, etc.

And a Planetarium.

Surrounded by 30,000m^2 of permanent exhibitions, the "La Villette" Planetarium will be one of the principal attractions of the city. The Planetarium is protected by a cylindrical envelope of 26m diameter which has been decorated by Monory, a French artist.
- The dome size is 21.5m.
- Audience capacity is 270. The seats are movable according to two axes.

INSTRUMENT DESCRIPTION

There are 3 main kinds of equipment:

1—Astronomical simulator

The simulation equipment is the Space Voyager by Spitz Space Systems. It will enable us to present a complete view of the solar system from anywhere within it. The simulator is complemented with a multisource projector fed by active planet images. These images will be projected on the dome with sizes between a few arc minutes to 20 degrees in diameter.

2—Auxiliary projectors

- About 125 slide projectors are installed in the circular projection gallery and the central pit. Some of them can cover the whole dome to offer one solid spherical image.

- A 35 mm film projector and a video projector are each able to show a 10m active image inserted inside the panorama image.

- A videograph will be used during show production or in real time to answer some of questions from the audience. This way the animator of the show will be able to use the dome screen as a video blackboard.

- The set of auxiliary projectors is complemented with special effects projectors.

3—Sound system

A polyphonic sound system provides a full sound spatial environment through 24 loudspeakers, 21 sound tracks and a mixing console of 36 voices. Each show will be translated into 3 languages.

SHOW PRODUCTION

One goal of the "La Villette" Planetarium is to present different shows to every kind of public audience:

- Shows about astronomical themes
- Shows for youngsters, for school-age children, special shows with theater, poetry, lectures, etc.

For the first show, we intend to approach astronomy in an original way. People with different backgrounds work with us on the show:

- Michel Butor, one of the most famous French writers, wrote a great poem "Breaking Through Space."
- François Bayle, a musician from a well-known French research musical group, composed original music.
- we worked with an external show producer.

"Breaking Through Space" means 3 rhythms, 3 perceptions, 3 travels:

- Yesterday or the Heavens: a return to the past. Man uncovers the mysteries of celestial mechanics.
- Today or the Orbs: the epoch of the spatial conquest.
- Tomorrow or the Worlds: a mental travel through the universe.

We are producing another more didactic show about the solar system, its birth, its evolution, its death. This show will be presented to the public by the end of this year.

These shows are planned to last 45 minutes including 30 minutes of automatic show and 10 to 15 minutes under the animator's control. The animator will have some short audiovisual sequences of 1 to 2 minutes duration about astronomical subjects or to answer the public's questions.

To create the planetarium shows, the internal team of the planetarium is assisted by a scientific committee composed of 12 astronomers and Mr. Levy, the President of the Center for Science and Industry. This committee determines the scientific and pedagogical orientations of this activity.

Program production is planned to be three shows per year. For its opening in October and during the first months, the planetarium will present five shows per day, and the number of shows will grow a few months later. ❑

Modems to Mars

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The planning of future planetary missions, temporarily set back by the recent *Challenger* tragedy, has gone on within NASA, as well as within organizations outside of the space agency. In particular, missions to Mars have been the focus of well over 3000 papers, books, and popular science articles, published by research scientists, college students, established authors and others interested in the idea of manned Mars missions. Interest in this topic is so high that a program of Mars missions has been recommended by the Reagan-appointed National Commission on Space as one of the US space goals for the next 20 years.

Important Mars mission planning activities has occurred in recent years, in a variety of settings. In 1981 and 1984, for instance, the Case For Mars Conferences were held at the University of Colorado at Boulder. In attendance at these events were many of the nation's top Mars researchers. During the course of the meetings, papers were given which outlined the feasibility and execution of planned Mars missions. The conferences were held under the auspices of the Boulder Center for Science and Policy, and were sponsored by The Planetary Society, National Space Foundation, the University of Colorado, and other interested groups. One result of these conferences has been the establishment of The Space Network—a computer bulletin board and information service for use by scientists, researchers, educators and students interested in the larger issues of space exploration. The board is maintained by The Boulder Center for Science and Policy, and is intended to be a communications facility for users; a place where they can share their knowledge. Presently it maintains information files from over two dozen institutions around the country.

A significant section of this board has been dedicated to The Mars Institute, an autonomous part of The Planetary Society. The Mars Institute provides such educational information as bibliographies, audio-visual suppliers lists, curricula and sample programs from educators who have formulated coursework concerned with Mars missions. The creation and correlation of a great deal of this information was done by the author of this paper. As a sub-board, the International Planetarium Society section adds a new dimension of communication between members of the planetarium community. You are encouraged to use it, and make your contributions.

In typical use, educators interested in teaching Mars missions call the board, using computer and modem. Once "logged on", they proceed to the Mars Institute Education section, and browse through the bibliographies, course outlines, curriculum offerings, and other information. Whenever the educator spots an item of interest, he or she is able to copy ("download") that information, and use it at his or her leisure. The board has been up and running since December, 1985, and has been publicized in *Space World*, *The Planetarian*, *The Planetary Report*, and *The High Altitude Observer*.

The Space Network number has also been publicized on a number of space-interest bulletin boards around the world. There is no cost to users of the board, except for long-distance phone service from their location to the Boulder location of the board. Numerous calls are received each day from everywhere in the country and around the world, including Europe and Australia.

The Space Network has established a section dedicated to The International Planetarium Society, and is actively seeking support and participation of other space-interest groups. The National Commission on Science used the board to receive commentary, which was then used in creating the report "Pioneering the Space Frontier." The National Space Society sends a weekly "space news" update from Washington, D.C. Other organizations contributing to and using the board include the NASA research centers, World Space Foundation, the University of Colorado, and the American Astronautical Society.

The Space Network, through the Mars Institute Education Board, presents a unique opportunity for educators to access timely information about Mars and other space-related missions. As more educators gain the opportunity to submit their course outlines and suggestions to the board, the database of educational activities will increase.

BOARD DATA

Phone number: 303-494-8446. Hours: 24 hours a day. baud rates: 300/1200/2400. Cost: there is currently no board charge to user (applicable long-distance charges apply).

For further information and a one-page sheet about logging on to the Space Network, write to:

Carolyn Collins Petersen
Mars Institute
BCSP P.O. Box 4877
Boulder, Colorado 80306 U.S.A.

When calling the network, address questions to "SYSOP" or "CC PETERSEN." ❑

The Road To Hawaii, A Planetarium Program With Interactive Exhibits On Polynesian Voyaging

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ABSTRACT

Captain Cook was the first European to explore much of the Pacific Ocean and its islands. He discovered a thriving civilization with a surprisingly homogeneous culture dispersed over tiny islands. How did these people get there? And how might they have used astronomy to guide their way over thousands of miles of open ocean? Attempts to answer these questions have been undertaken by humanists and scientists from many fields, including archeologists, oceanographers, linguists, and a multidisciplinary team who are currently retracing the ancient routes in a twin-hulled canoe, using only their knowledge of the sea and stars to guide them. The story of these efforts, and our current understanding of the settlement of Polynesia, will soon be told through a participatory planetarium program and a series of interactive exhibits now being developed by the staffs of two museums with planetariums located in Hawaii and in California.

INTRODUCTION

"The Wayfinding Art: Ocean Voyaging in Polynesia" is an exciting joint project of the Lawrence Hall of Science, University of California at Berkeley, and the Bernice P. Bishop Museum, Honolulu, Hawaii. Partially funded by a grant from the National Endowment for the Humanities, the project will create a major exhibition and participatory planetarium program to communicate how scientists and humanists of many disciplines have collaborated to learn about where the Polynesians came from, the methods they used to construct and sail ocean-going canoes, and how they might have navigated between islands dispersed over the vast Pacific Ocean. "The Wayfinding Art" will open at the Lawrence Hall of Science and the Bishop Museum in September, 1986.

A PLANETARIUM PROGRAM *THE ROAD TO HAWAII*

The fifty-minute program, with audience participation, is co-authored by Will Kyselka of the Bishop Museum Planetarium and Cary Sneider of the Holt Planetarium at Lawrence Hall of Science. The program opens under Hawaiian skies, with a storyteller recounting part of the ancient Legend of Moike'a, in which the Chief selects a captain for a journey back to his homeland in Tahiti to bring his son to Hawaii. The instructor explains that for many years, anthropologists debated whether or not such voyages were even possible, across nearly 3,000 miles of open ocean. The Hokule'a experiments found that it is indeed possible to navigate without instruments and sail a twin-hulled canoe between Hawaii and Tahiti.

The visitors learn about Micronesian navigator, Mau Piailug, who guided Hokule'a on its first voyage, and Nainoa Thompson, the young Hawaiian who learned from Mau and evolved his own method of navigation. The visitors learn how to determine direction by using Nainoa's star compass (adapted from the traditional Micronesian star compass) and how to determine their altitude by measuring the height of Polaris. Then, the audience travels south to Tahiti, to find Moikea's son, and bring him back to Hawaii as in the ancient legend.

Starting their journey under Tahitian skies, the visitors must use what they learned earlier in the program to navigate back to Hawaii. First, they plot a course which will carry them well to the east of Hawaii, allowing for currents and leeway. When they have reached the right latitude (determined by the height of Polaris) they will turn downwind and sail west to the Big Island of Hawaii. On the journey northward the visitors learn about the plants and animals they have brought along, and how to steer the canoe using the sun and waves when the stars are not visible. They will hear Nainoa's words about the difficulties he encountered in the doldrums and his unique way of dealing with them, and finally they will use birds to guide them to a happy landfall in Hawaii.

A SERIES OF EXHIBITS "Experiment and Excavation: Keys to the Wayfinding Art"

Outside the planetarium there will be several interactive exhibits which will enable visitors to place into broader perspective the methods of navigation that they learn about in the planetarium program. These exhibits are now undergoing formative evaluation by the staff at Lawrence Hall of Science under Exhibits Director Jennifer White. They are briefly described below.

The Globe Exhibit: "Where did the Polynesians come from?" Visitors will see this challenge suspended above a six-foot diameter half-globe on the floor, showing the entire Pacific Ocean with the coastlines of continents around the edges. Alongside the globe there will be a panel with maps of each major island group in Polynesia. By pushing buttons next to the maps, visitors will be able to see how tiny and widely dispersed are the islands of the Polynesian Triangle. A second panel will invite visitors to "speed up time" and view the tradewinds sweep across the globe from east to west, and to see how that pattern changes during rare El Nino seasons (with the assistance of rotating polaroid filters).

Early Theories: Visitors will see a large sign, "Early Theories," below which are four smaller panels, each with a cartoon of one early theory for the origin of Polynesia. The theories will be: 1) God brought them, 2) The Polynesians once lived on a continent that sank into the sea, 3) They are from a continent to the south, and 4) They came from the Americas. Visitors will be invited to lift each panel and see the evidence for and against that idea.

Today's Theory: This large panel is a map showing major island groups in the Pacific. By pushing one of the buttons marked with dates, visitors will see an arrow light up, showing migration patterns that took place during that period. An information panel which also lights up will show some artifacts from that period and describe some of the technology. The series of arrows will show the widely accepted migration route from a homeland near Indonesia across the Pacific to Tonga and Samoa, then to Tahiti and the Marquesas, and from there north to Hawaii, southeast to Easter Island, and southwest to New Zealand. The information in "Today's Theory" is supported by archeology and linguistics as illustrated in the exhibits described below.

Where Did the New Zealanders Come From?: Visitors will have the opportunity to solve a real archeological puzzle by handling replica artifacts from New Zealand and by comparing them with similar items from digs on Samoa, Tahiti, and the Marquesas. The realistic fish hooks, poi pounders, adzes, and patus will be arranged in dated layers of sediment. Visitors will be surprised to discover that the New Zealanders did not come from the closest island groups.

Excavation at Huahine: This series of photos and panels will present the work of Dr. Yosihiko Sinoto and his team of archeologists from the Bishop Museum who have been excavating one of the most amazing discoveries of the century. A thousand years ago, on the island of Huahine, a short distance from Tahiti, there existed a community of craftspeople who produced adzes, graters, and ocean-going canoes far beyond local needs. The remains of uprooted trees and other debris indicated that the community was innundated by a tidal wave, thus waterlogging and preserving wooden artifacts including huge canoe planks and steering paddles. The exhibit will include a full-size replica of the paddle that was found there, a map of the area, and a brief text describing the implications of the find.

Ethnobiology: Visitors will view a section of an archeological dig in which they will see dated layers of sediment. Information on a side panel will help them identify pollen grains, bones, and other remains that indicate flora and fauna that existed at different periods. The results of such detailed analyses will be dramatically portrayed through two paintings showing the island's flora and fauna before and after human settlement. Visitors will be invited to sort representations of food items into two "food baskets" representing the available food before and after people came to the island, illustrating the many plants and animals that the Polynesians carried with them on exploratory voyages.

Canoe Design: When Captain James Cook first explored the Pacific, he was met by the local inhabitants in outrigger and double canoes. Many of these vessels carried large numbers of passengers and could sail circles around the cumbersome European ships. Visitors will observe the differences among these vessels through etchings, photos, and models.

Sailing Simulation: A computer simulation will allow visitors to "sail" a canoe from one island to another by using a game paddle to select the direction. Visitors will learn that they cannot sail "into" the wind, but must sometimes zigzag or "tack" to make their destinations. In formative evaluation, this computer game has generated a great deal of interest and excitement.

Canoe Technology: Visitors will have the opportunity to try their hands at using a Polynesian Pump Drill made of shell, wood, and coconut fiber twine.

A Map of the 1985–7 Journey of Hokule'a: This map will show the route of the current voyage of Hokule'a to retrace ancient migration routes of the Polynesians using non-instrument navigation techniques. The map will be updated weekly to show the crew's progress.

Essay Collection: In addition to these exhibits, the Wayfinding Art project will produce a collection of essays to allow visitors interested in learning more about Polynesian voyaging to read articles by a wide variety of humanists and scientists who have collaborated on this exciting area of research and cultural revival.

If additional funds can be raised, The Wayfinding Art project will produce an interactive exhibit on linguistics, an additional computer simulation of exploratory voyages, a lecture series, and an educational program for local schools in Hawaii and California. Additional funding will help us to greatly enhance the exhibits described above and to fund opening events and publicity.

Many people have worked hard to bring The Wayfinding Art to its current state of development. We would like to thank: Yosihiko Sinoto, David Kemble, and Pat McCoy from the Bishop Museum; Nainoa Thompson, and Myron Thompson from the Polynesian Voyaging Society; Ben Finney, Dixon Stroup, Tom Speitel and James Sadler from the University of Hawaii; Lawrence Dawson from the Lowie Museum; Alan Friedman from the New York Hall of Science; Jennifer White, George Corrigan, Wendy Kitamata, John Fredericks, Maryta Parkhurst, Lisa Baker, Tom Burke, Arline Dehlinger, Laurie Edwards, Sue Jagoda, and Mark Menaghetti from the Lawrence Hall of Science, and officers of the National Endowment for the Humanities.

Other museums and planetariums are invited to copy or adapt The Wayfinding Art planetarium program and exhibits. Those who are interested should write to the author, concerning which parts of the program they are interested in replicating. Other comments and suggestions are welcome.

This paper was previously presented at the Joint Conference of the Pacific Planetarium Association and Rocky Mountain Planetarium Association in Salt Lake City, Utah, October 10-12, 1985. ❑

A Software-Intensive Design For Planetarium Control

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To reduce costs in large multi-media controller applications, I designed a system that utilizes a minimum hardware configuration, while achieving full flexibility through efficient software design.

The development of automated planetarium control systems has come a long way in the past ten years. Now, virtually every new installation has an automation system included in its design, while directors and technicians of older facilities look to upgrade their theaters with the latest in control systems. In either case, the cost of the system is a major concern that often leads to a compromise or delay in implementation. If sufficient funding is not available, the solution is either to partially automate the theater or to wait for more money. Not wanting half a system, and tired of waiting, I have taken another common approach: designing my own system.

Starting with a clean slate, I sought to eliminate as many obvious limitations in the control system as possible. The first was the number of projectors which could be controlled. In the case of the Kendall Planetarium, a 40-foot theater, there are some 250 individually accessible circuits. Tripling this would allow ample headroom. Second, manual control of the theater should be a fully implemented feature of the automation system rather than a separate system or an add-on. And finally, the system should be entirely modular, utilizing plug-in units for service or expansion.

As in any computer control project, you can chose to accomplish a task with hardware directly, or with software that emulates a particular set of electronics. Many control systems control as few as two projectors per microprocessor. In these systems, a master computer (or tape) orchestrates the show, sending encoded cue data to each slave computer, which then must decode the data and actuate the dimmers and switches to run the projectors. The data signals themselves are often converted back and forth from digital to analog forms in the process. Most of these computers' time is spent converting data, or in idle loops waiting for cues. The cost of the electronics for this scheme easily becomes prohibitive.

In a software-intensive design, the electronics are kept to a minimum. In my design there is only one microprocessor for up to 750 projectors. There is no digital to analog conversion; all communications and projector controls are direct digital. The layout consists of up to 250 output modules connected to the computer through a single parallel ribbon cable. Each module controls three projectors plus two auxiliary channels. In fact, there are no "dimmers" in the system. The modules consist only of the electronics necessary to respond to the computer with a specific lamp level or on/off switch.

To operate a projector, data are sent from the computer to select an individual projector channel. Then another data word is sent to select a lamp level or switch state. To effect a fade, the computer must send new lamp levels to the modules thirty times a second. Although this may sound like a tremendous task, less than half of the available processor time is used even when fading 125 projectors simultaneously!

The control program, which is the heart of the system, is written in assembly language for speed. It operates on two different levels. The background portion of the program takes care of changing lamp levels and switch settings. It also updates the show clock and makes sure the show is in sync with the audio tape. The foreground part of the program checks for upcoming cues, scans the keyboard and console for commands from the operator, and displays any messages regarding operation. It is this two-level programming technique that allows such a substantial reduction in the amount of electronic hardware.

All of this is outwardly transparent to the user. To operate the system, you simply type in the cues from the keyboard or execute them from the console. All show information is stored in the computer's memory. No cue data is placed on the audio tape. Cue numbers and "time to next cue" (often confusing information) are not implemented. Instead, absolute time from the beginning of the show identifies a cue. Simultaneous events are simply given identical times. Cue timings and fade rates may be selected to within one-thirtieth of a second. Groups of cues may be identified with a label which may then be called as a single command. This allow you to create your own animation routines. Editing the cue list is as easy as using any word processor. You may change, move, insert, or delete cues to fine-tune your program.

Perhaps the most important feature of the system is its lack of sophisticated electronics. Since the system features are written into the software rather than designed into the hardware, upgrading the control system is as simple as plugging in a new memory chip.

While several companies offer excellent full-feature planetarium control systems, many are out of reach of a limited budget. A software-intensive approach to control design allows large systems to be constructed with greater flexibility at significantly reduced costs. ❑

The Astronomy Class: Sleep Aid Or Valuable Learning Experience?

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What are the factors which make for successful astronomy classes? What topics and strategies produce the best learning experiences, the greatest student involvement and enthusiasm? To find the answers to these questions, I conducted an informal telephone survey of various planetariums. Many of the results were predictable, but some results were unexpected.

To the question, "Does your planetarium do public astronomy classes?" for example, I found that many planetariums do not offer any sort of astronomy classes to the general public or to school students. I feel that this is a mistake both in terms of good public relations and support (membership programs, etc.) and in terms of the missions of those institutes. The public wants a live, knowledgeable person who can provide more information than is contained in either a canned or live planetarium program.

You may be concerned about the time necessary to conduct classes. At Hansen, the education department contracts with instructors, members of the local astronomy club and part-time staff with special training. All classes are offered on a break-even basis based on instructors being paid $12.00 per hour. Each instructor is encouraged to create and introduce new courses. This has resulted in a great variety of popular classes for students ranging from preschoolers to retired people and everyone in between.

Popular topics for classes: In planning astronomy classes, it is important to offer topics that will be popular. From my survey, the following topics emerged as popular enough to fill the classes regularly: For kids these topics were: model rockets, exploring the solar system, robots, dinosaurs, and UFOs. For adults the most popular topics were Comet Halley, exploring the solar system, new discoveries, and telescope building.

What classes are the most popular (largest number of students)? The title of the class seems to have a great impact on popularity. For example, which of these two classes on Comet Halley offered last year would interest you more: *Comet for the Ages* or *How to Survive Halley's Comet*? At Hansen, we discovered that including the word "astronomy" in the title of a public class offering was the "kiss of death" for attendance. Here are some successful class titles: *Rockets for Junior Astronauts, Robots are Here! UFOs* and for adults: *Stargazing for Backpackers, What Happened to the Dinosaurs?, Search for Extraterrestrial Life,* and *Build Your Own Telescope!*

Which classes are least popular? Here are the losers, the classes that consistently draw small numbers of students or have to be cancelled: using or buying telescopes, gaming, archaeoastronomy, history of astronomy, and medieval astronomy.

How are classes advertised and promoted? Successful class promotion is important. Planetariums use in-house membership lists and mailing lists of former students, newsletters, brochures, live radio call-ins, news releases, and co-sponsorship with community education groups.

Valuable learning experiences: I asked planetarium educators to describe learning experiences which produced the greatest student involvement and enthusiasm. The answer, heard over and over was "hands on." I then asked them to give me an example of a valuable learning experience. Some examples: building and using a telescope; building and launching a rocket; building and programming a robot; and constructing and using star finders. A distinction was drawn between "real hands-on activities" and "contrived interactive activities" which are not. Adults and young students all like to take home things they have built and can use.

Poor learning experiences: Learning experiences which produced the least student involvement and lowest enthusiasm included straight lectures (including slide programs), use of lots of numbers or historical dates, and situations with poor teacher to student ratios.

Summary: The strategies which produce the best learning experiences, student involvement and enthusiasm are a knowledgeable and enthusiastic teacher, good well thought-out activities, and thorough preparation. ❑

Goals For Astronomy Education In A K-12 Curriculum

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Since astronomy is a basic science, students should be introduced to astronomy as both a body of knowledge and as a process for learning about the universe. Through the study of astronomy, students should acquire the appropriate attitudes, process skills, and basic knowledge important to the scientifically literate citizen. It is the position of The Great Lakes Planetarium Association that the following goals for astronomy education should be met by students completing a K–12 curriculum.

The student should understand the following:

A. Visible Objects.
1. The Sun
2. The Moon
3. Stars
4. Planets
5. Meteors
6. Eclipses
7. Comets

B. Time
1. That the measurement of time is based on the motions of the earth and moon.
2. How the direction north can be found by using the stars of the Big Dipper.
3. That the sun's direction in the sky at sunrise and sunset changes with the seasons because of the orientation of the earth's axis in space.
4. The weather changes with the seasons because of the changing angle of the sun above the horizon and the varying length of daylight.
5. A number of constellations which can be seen in various seasons.

C. Solar System
1. The sun is a star at the center of the solar system. orbited by the planets.
2. The names of the planets and their orbital arrangement relative to the sun.
3. Major physical characteristics of the planets and how scientists believe these properties were acquired.

D. Stars.
1. That stars vary in size, temperature, brightness, and color.
2. How various types of stars are believed to form, change, and evolve to their end-states, including phenomena such as white dwarfs, pulsars, supernovae, and black holes.
3. That the sun is an average star as compared to stars in general.

E. Universe.
1. That galaxies are large systems of stars held together by gravity, and that the universe is thought to contain billions of galaxies.
2. That the sun is only one of the billions of stars that constitute the Milky Way Galaxy.
3. That astronomers have observed galaxies moving away from the Milky Way in all directions, and therefore conclude that the universe is expanding.
4. How scientists believe that galaxies and the universe formed and are evolving.
5. How scientists believe life began on the earth.
6. What scientists believe to be the requirements for life to exist elsewhere in the universe.

F. Astronomy Tools.
1. What methods and tools are used by astronomers.
2. How major developments in the history of astronomy have influenced our culture.
3. The difference between astronomy and astrology.
4. How spacecraft have contributed to the science of astronomy.
5. The basic requirements of spaceflight, such as energy, propulsion, orbits, communication, and life support.
6. How space exploration benefits mankind. ❑

Laserdisk Hardware and Software

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LASERDISK PLAYERS

There are three basic types of consumer laserdisc players: the toploader, front loader and combination CD/laser disc player. Almost all are made by Pioneer in Japan, though some have other brand names. They all can be purchased for between $200 and $900. In addition there are more expensive commercial players. I have owned three different models of laser disc players. Recently other Japanese companies have designed and marketed their own players, but I have not had experience with any of them.

TOP LOADERS

For educational institutions I recommend the Pioneer 8210, a toploading machine with a solid state laser. It has a rather plain exterior and takes up more room than the front loaders but is slightly better constructed and built for more industrial use. It is a best buy especially since Pioneer recently reduced the price to $299 and was offering $175 worth of laser discs free with the purchase in a special promotion. Several stores have advertised a discounted price of close to $250.

The cheapest way to go is to find a used Pioneer 1000. This is a top loader and has been long discontinued. It was the original Pioneer model and is a bargain only if it is free or almost free ($50 or so). It has a gas laser which will probably expire and cost $175 to replace. In addition the gas laser does not produce as sharp a beam as the solid state lasers in the other models. This leads to more mistracking.

Other discontinued models include the top loader 1100 and 660. The former can be a good buy if cheap enough, though it does not track as well as the newer models. Avoid the 660 which is no good at all since it does not have random access, essential for the space discs.

FRONT LOADERS

One step up is the Pioneer 700, also sold under Sylvania, Magnavox and Teac brands. It has the identical laser and operates almost identically to the 8210. The front loader saves space and looks a bit sleeker. It has been widely advertised for around $600, but the other brand mates, particularly Magnavox and Sylvania are often sold for $400 or so. It is another best buy at that price, particularly if there is a space problem.

CD/LASER PLAYERS

The top of the line is the Pioneer 909. It has the same laser but also plays compact discs (audio) and decodes digital sound which is encoded on some recent laser disc movies. It retails for about $900. It replaces the Pioneer 900 which is also sold by Akai and Teac. This recently discontinued model is being discounted now, but had a much higher original price ($1200). The 909 is considerably smaller than the 900.

COMPUTER HARDWARE/SOFTWARE

Our experience is with an Apple II+, single diskdrive and Video Vision interface and LaserWrite software. I highly recommend a dual disk drive which saves a lot of time when copying disks and writing with LaserWrite. Optical Data Corporation (formerly Video Vision) supplies Apple ProDos with LaserWrite and the software is quite user friendly.

LASERDISKS

Optical Data Corporation markets two lines of laser discs. The first is the Space Disc series, now composed of 6 discs: Apollo, Space Shuttle, Voyager, Sun, Astronomy and Earth Science. Each is very densely packed with both slide images and movies. They are very expensive, approximately $300 each, though not expensive considering the amount of information on each disc. In addition there is a set of Space Archive Discs at about $40 each, marketed for the general public, with a much lower density of still photographs, about 800 per disc, in addition to movies. Last year Video Vision conducted a detailed survey of the owners of their Space Archive discs and offered to sell the Space Disc series for $99 each. This is how I obtained the Space Disc series.

For those on a budget and not able to order all of the discs, my recommendation for purchase of discs would be in the following order: "Astronomy" (Space Disc #5; by far the highest priority; one could teach an entire astronomy course from this disc), "Mars and Beyond" (Space Archive 3), "Apollo 17: Mission to Taurus Littrow" (Space Archive 2), "Sun" (Space Disc #4), "Space Shuttle" (Space Archive 1), "Greetings from Earth" (Space Archive 4), "Voyager" (Space Disc #1), "Earth Science" (Space Disc #6), "Apollo" (Space Disc #2), "Shuttle" (Space Disc #3).

I understand that a new Space Archive disc entitled

"Encounter on Comet Halley" and "Voyager Uranus" will soon be released as well as a "Life Sciences" Space Disc.

TEACHING MODULES

This summer [1986] Dr. Billy A. Smith and I will prepare a series of teaching modules using the Space Disc and Space Archive laserdiscs and the LaserWrite program. The attached Saturn module is an example. They are intended to be used during general astronomy lectures at the introductory college level. They will not be designed for laboratory or planetarium use, although they may be adapted for those purposes. We would like to share our work with others possessing the same hardware and software (Apple II+ or IIe). If you have written modules which you would also like to share and/or would like copies of ours, Dr. Smith and I would be willing to serve as a central coordination point and copy floppy disks, as well as maintain and distribute a list of available modules. Please write us of your interest and what modules you are willing to share.

LASERDISK TEACHING MODULE #8: SATURN

LASERDISC(S) USED: Voyager (SpaceDisc #1) Side 1. Load Disc into player, close lid and turn power on. Disc will automatically spin up to speed.

User commands such as PRESS SPACE BAR or CHOICE are only recognized when INPUT? or CHOICE? appear in the lower quarter of the screen.

N.B. Time between slide changes is variable depending on the material presented to allow lecturer to explain content while slides are being shown. Also pauses are built in to allow more detailed explanations, with continuation only after pressing SPACE BAR. Review prior to presentation.

ACTIVITY MENU:

1. *Voyager 1* Preview Movie — TIME: 5:00
Begins with launch dates and fly-by trajectory. Computer simulation of fly-by is only fair, since it was made before the encounter. Film cued by pressing SPACE BAR.

2. *Voyager 2* Preview Movie — TIME: 5:00
Begins with launch dates and fly-by trajectory. This is the better of the simulations, since it used *Voyager 1* data. There is also more detailed explanation of the experiments, particularly the non-imaging ones. Film is cued by pressing SPACE BAR.

3. Atmosphere — TIME: 2:00
Begins with still of *Voyager 2* approach. Movie of circulation of northern hemisphere atmosphere is cued by pressing space bar. Stills of clouds, circulation follow. Pressing SPACE BAR cues enhanced contrast images.

4. Moons — TIME: 1. 0:45 2. 3:00 3. 3:00
Menu to choose 1. Titan, 2. major (ice) moons or 3. minor moons. Titan shows atmosphere and haze layer. Major moons begin with Mimas and move outward to Phoebe. Pauses occur between Tethys and Dione and during Iapetus to allow for explanations. Minor moons divide into three groups: the Trojans of Tethys and Dione; the coorbitals with a film played twice explaining their motion; and the A and F shepherding satellites.

5. Rings — TIME: 2:45
Begins with polar view diagram and illustration, then general views of the rings. A spoke series is next. Several anomalies follow including ellipticity, braids, F ringlets, G and E rings. Film of the spokes ends the section.

TIME given above does not include time taken for explanation during pauses in the material. ❑

In Defense of Mythology

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From time to time all of us use sky lore in our programs or lectures. Outdoor talks almost always seem to include some sort of lore or legend. These legends might be included as a filler or as pure entertainment or for some other reason. I'm sure that there are as many reasons as there are myths. At times, too, whole shows will focus on mythology of the heavens. This is good, but such presentations might possibly be improved somewhat if one considers including some background information about myth.

IMPORTANCE OF THE SKY TO THE ANCIENTS

Most myths come from out of the mist of ages long gone. In those times people everywhere looked up and studied the heavens. They saw order in the chaos—they formed the constellations. They saw reason in the motions of the sun—they explained the seasons. They saw sequence in the moon's travels—they established the calendar. The sky was eminently useful and, hence, became the subject of discussion.

The sky was the source of life-sustaining rain. As the sky gave rain, it also was the home of the sun that could warm the earth after a long winter or parch the earth during a long summer. The sun provided light by day, and the moon, whose abode was also the sky, gave light by night. It was from the sky that winds and snows came. This sky was a shepherd of man at one point; it was a killer of man at another.

Starry night skies kept the wary company and lead the lost one home. The North Star, the Home Star, held true to its course night after night serving as a guide post and a constant reminder of directions. The rising and setting of the sun and moon, too, was a guide to direction.

Monthly sojourns of the moon and the annual walk of the sun was a device for keeping calendar. Months and years were established based on their motions. The time to plant or harvest, the time to migrate, the time to store up food, was all determined by the relative patterns of sun, moon, and stars.

High above the earth, in the sky, the spirit gods dwelt. It was to them that supplication was made with up-turned eyes. The sky was the place from which mankind originated; it was the place to which he would return upon death. Man's fate was written in the sky according to some. By knowing the sky man might know himself.

Nightly the heavens wheeled overhead. Annually the Bear began his long journey only to repeat it time and again. Because people saw things in the sky they used them to record events and tell stories of important things that happened.

The sky, because it seemed to draw mankind upward, was awe-inspiring. It was as if a road opened up before one who contemplated the heavens. Indeed, a shimmering, silvery pathway lay just above. One who contemplated the heavens was dwarfed by its glorious nature and tremendous size.

It was for these reasons that people held the sky in severe reverence. The sky was almost everything to everybody. In fact, one's very life could depend upon the goodness or predictability of the sky. Mankind had no choice but to stand in awe of the heavens.

PERCEPTIONS OF MYTHS

Myths are not to be thought of as cute, trite, or meaningless. Only one poorly versed in the understanding of myth would ever make that claim. The fact of the matter is that myths served (and continue to serve) many useful purposes. Only by examining select myths can this truth become self-evident.

From the story of creation (be it American Indian, Hindu, Japanese, Judeo-Christian, etc.) man hears of his relationship to the creator and to other creatures. Perhaps you've heard the adage "Brother of the Beaver and Sister to the Stars." This sort of saying could only have come about from a creation myth that explained the relationships of all created things. Man, as "brother to the beaver," should be respectful of all life forms. Frequently today this lesson seems to have bypassed some who pillage and destroy the land for greedy gain.

Stories of the past, though not "scientific" in their outlook, explain the nature of the physical world. Why does the "possum" have a rat-like tail, and why is a buzzard bald? Why is it hot in summer and cold in winter? Why does the sun migrate along the horizon at rising and setting throughout the year? What are those eerie lights that fill the sky at night? Myths provide the answers to these questions and make man less fearful and more comfortable with his world.

The legends handed down from generation to generation help to recall important physical relationships. What is the relationship of the North Star to the directions? What is the relationship of the sun's rising and setting points to the seasons? Myths which were told time and again drive home the point. The myth was a way of remembering these relationships and passing them on in a lively, entertaining, and memorable fashion.

Personal duties are important to every society. The chief is expected to lead his tribe, the young men to hunt, the others to prepare the food. Legends were one way of explaining the personal duties and of providing role models for appropriate actions. Everyone has heard lore of how coyote messed up the night sky because of his impatience. The young heard of the consequences of impatience and were counseled against it in the legend of coyote.

Tribal customs were made known and passed along through legends. The heroes and heroines of the tribe were pointed out and their works described. Tales of the hunt were relayed and the methods utilized were described in detail. Religious ceremonies were described and weird events told of.

Certain moral truths were also explained through the use of legends. The Milky Way with its "Point of Decision" was pointed out and the value of leading a good life noted The two dogs of the Milky Way were pointed out and the features of death and burial were described. The stars were the campfires of the dead pausing in their journey to the Happy Hunting Ground. Moral truths of life after death were clearly pointed out in the night, looking upward to the very place where man would return upon death.

Many myths, steeped in historical fact, also helped to pass down the history of a group of people. The heroes were placed among the stars as a constant reminder of their deeds. Mankind was constantly under the watchful eyes of the ancestors, and there ancestors were there among the stars for all to see.

Myth was also good entertainment. The sky served as a way of relating myths...some told just for the fun of it. How enticing the sky is as a tool for telling stories when a group is gathered around a fire on a cool autumn evening.

EMPLOYING MYTHS

Myths are unique products of unique cultures. By studying myths of a culture we can learn much more about the people than we would, say, from an arrowhead or a broken piece of pottery. Legends tell us not only how a people thought, but what they thought. These legends of the sky can tell us how people relied on earth-sky relationships in keeping time and finding directions.

Myth can help one take a deeper look at the world and appreciate one's position in it. Though we "know" more about our world today than the ancient ones did in their time, we still have much to learn. Who of the ancients would have polluted and ravaged a world for personal gain when he was brother of the very beaver who had to share the world with him?

When we employ myths in our work, we must remember that we are the windows through which others see the world of long ago. If our window on the past is jaded, then the view that people get of the past is distorted and wrong. We must understand the meaning and value of lore if we are to present it in a useful and meaningful way. Relating a myth without drawing out the moral or essential truth of the story is defeating the very purpose for which it was created.

(For a considerably more complete treatment of myths the author of this article refers you to his extensive introduction to the book *Mythology for Young People: A Reference Guide*, by Rita Kohn, Garland Publishing, Inc., New York, 1985. The reference guide contains several hundred listings of excellent and widely available resources relating to lore. Additionally, the introduction contains a lengthy unit plan for the use of sky lore in the classroom and planetarium setting. ❑

Astronomy and Space Science In the Era of Space Weapons

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ABSTRACT

This paper is a brief exposition of an emerging problem related to recent advances in technology: the increased conflict between opportunities for the scientific exploration of space and proposals for the military exploitation of space. Major technologies related to the proposed U.S. Space-Based Ballistic Missile Defense System, Strategic Defense Initiative (SDI), are presented, including a discussion of intrinsic problems dictated by the laws of physics and astrophysics. The impact of SDI research on space science is reviewed, including examples such as the recent destruction of a satellite for military purposes and the planned military usage of the Space Shuttle. In concluding, a note is offered concerning the implications of space weapons for the future of life on this planet.

HISTORY

On July 20, 1969, humans first set foot on another world. Attached to their lunar landing vehicle was a plaque containing the inscription:

HERE MEN FROM THE PLANET EARTH
FIRST SET FOOT ON THE MOON
WE CAME IN PEACE FOR ALL MANKIND

It is peaceful, scientific missions that most people have in mind when they discuss space projects. These range from the American Viking Landings on Mars in 1976 to the recent Japanese, European and Soviet spacecraft encounters with Comet Halley. In addition, we humans have begun to use earth-orbital spacecraft to look outward at the distant stars and galaxies and inward at our home planet.

It is modern technology which has made possible these explorations in space. However, technology is not automatically beneficial. Our advances in new technology create new dangers. It is humans who decide what they will do with these new capabilities. In a democracy such as ours in America, it is the public whose assent is required for both the peaceful and military applications of technological innovations.

In our era we have unleashed the tremendous energy previously locked within the atom. We have been astonished by this success; we are quite unprepared for it; and we scarcely comprehend the possibilities and the dangers it introduces. The question presently being pondered by many of our most eminent scientists, as well as by a broad range of concerned citizens, is: how can we overcome our destructive modes of thinking and behavior and bring about the change which will insure the preservation of life on our planet?

This paper introduces the problem of how we will use technology by providing examples related to the development of space-age technology. Historically, the exploration of space has been dependent, to a great extent, on the development of rockets to launch spacecraft. In the early 1900s, the American rocket pioneer, Dr. Robert Goddard, attempted to interest the U.S. Government in funding his research into the peaceful development of rockets for space flight. However, it wasn't until after World War II that the U.S. and the Soviet Union would take a special interest in rocketry. It was the success of the German V-2 rocket, used in the bombing of England, that stimulated the superpowers to develop intercontinental ballistic missiles (ICBMs). These ICBMs were developed in the 1950s for military, not peaceful, use, and held nuclear-tipped warheads. In the U.S. these rockets were developed under the direction of the Department of Defense.

It wasn't until the Soviet launch of Sputnik into orbit in 1957 that it became politically possible to develop a civilian space program in America, under the direction of NASA. The rockets used to launch most American scientific spacecraft were derived from military ballistic missiles.

In addition to the peaceful space activities which both nations began to carry out in the late 1950s, the superpowers began to exploit space for military purposes. Military satellites were designed and built to be used for photographic reconnaissance. These "spies in the sky" make it difficult for the superpowers to hide significant activities from each other. Other important military satellites perform electronic surveillance and communications functions. The need for such satellites is very great, especially during times of international crisis. Because of the valuable service provided by these orbiting electronic spies, each of the two superpowers has sought military advantage by also developing techniques for destroying each others' spy satellites. Such systems are called anti-satellite weapons, or ASATs.

ASATs

Historically, the U.S. was the first nation to test ASATs. In the early 1960s, several such tests were made using the Thor rocket. In 1968, the Soviets began a series of test of their own ASAT. Several years later, both nations stopped these tests, with neither country having perfected a reliable ASAT system.

Although the Soviet Union has not resumed such tests, in the United States recent advances in technology, coupled with a new emphasis on military strength, have ushered in a new phase in the testing of anti-satellite weapons. Already, this testing has had an adverse impact on the peaceful exploration of space, as follows:

On September 13, 1985, a new U.S. ASAT weapon was tested against a target in space. Because problems had developed with the original test target, the Air Force decided to use its backup target called P78-1. P78-1 was an existing satellite which the Air Force declared had "outlived its useful life."

However, it was later discovered by reporters that at the time of the ASAT test, P78-1 carried two functioning astronomical observatories. One of these instruments, called Solwind, had been studying the solar corona for 7 years, providing valuable data concerning changes in the corona during the 11-year sunspot cycle. The other instrument had discovered a number of sungrazing comets.

On September 13, 1985, P78-1 was demolished. At present, there is no satellite which can duplicate all the observations made by P78-1, although the Solar Max satellite can supply some of the information lost by the destruction of P78-1. In turn, the history of Solar Max illustrates even more clearly some of the hazards introduced by military applications of space-age technology.

Last fall, *Comet News Service* described the situation as follows: "Solar Max is the satellite successfully repaired by the space shuttle crew. Ironically, its malfunctioning electronic boxes were found to be peppered by 160 tiny craters on their outer surfaces, caused by tiny paint chips that are part of the accumulating belt of orbiting man-made debris bullets caused by such events as the ASAT test that destroyed P78-1. The P78-1 test alone added 2% to this junkpile which can be lethal to astronauts and satellites. Yet the Pentagon has been authorized to conduct many more such tests, despite profound concerns expressed by NASA based on its experience with Solar Max. With the increasing militarization of the U.S. space shuttle program, it will ironically be the U.S. military which would be most affected by this cascading space pollution."

SDI

An even greater conflict between the scientific and military uses of space is arising as the U.S. proceeds with the development of President Reagan's proposed "Strategic Defense Initiative" (SDI), commonly called "Star Wars." The following brief introduction to this subject should be followed by a further examination of the many problems introduced by the proposed SDI space weapons.

(1). The deployment of SDI weapons is expected to cost Americans at least $1 trillion. Already, funding for space weapons research has necessitated large cuts in funding for non-military scientific research. SDI funding will be enormous due to the necessity to create whole new technologies to carry out the military objectives and due to the complexity and sheer physical size of the weapons system. The following examples illustrate how this diversion of funds is already affecting astronomical research, and will affect it in the future.

(a). About 2/3 of the Space Shuttle flights tentatively scheduled for the next few years are military in nature, and include tests of space weapons. This extensive use of the Shuttle leaves little room for scientific studies. Furthermore, the deployment of space weapons, estimated to begin in the mid-1990s, may require up to 5,000 Shuttle flights. This deployment will come at the same time as the planned construction of America's space station. Therefore it is likely that the construction of the space station will be postponed.

(b). One plan being considered for space weapons involves the use of lasers and giant mirrors to shoot down enemy missiles. In this plan, 75 large mirrors must be placed in geostationary orbit. Each mirror would be 2 times larger than the world's largest astronomical telescope. In addition, at least 200 mirrors of similar size must be placed in low earth-orbit to focus laser beams onto the ICBMs. Due to changes in the phase of the laser beam as it travels through the atmosphere, the mirrors must be designed to adapt to these changes. No one knows whether the development and deployment of such an optical system is technologically feasible.

(c). Another plan calls for an X-ray laser, stationed in space and powered by nuclear explosions, to direct X-rays toward an ascending missile. One problem with this system is the inability of X-rays to penetrate deeply into the atmosphere. Because the missile may traverse the atmosphere in less than 1 minute and deploy its warheads shortly thereafter, the X-ray laser (which is not able to destroy the warheads) has limited usefulness as a defensive weapon.

(2). Most importantly, the continued development of space weapons will, in a very short time, result in the abrogation of one of our most important arms control treaties: The Anti-Ballistic Missile, or ABM Treaty. This treaty, in halting the deployment of ballistic missile defenses, led to the negotiation of the SALT I & SALT II Treaties, which limit the number of nuclear weapons on both sides. If the ABM Treaty is abrogated, so too will be the SALTs. The result will be an escalation of the nuclear arms race, both on earth and in space.

Already, the numbers and types of existing nuclear weapons systems have led arms control experts, including leading scientists and physicians, to state that "we are living on borrowed time." An escalation of the arms race will further increase the probability of a nuclear war, either by accident or by design. It is this ever-increasing likelihood of the use of nuclear weapons, and the resulting global effect (noted below) due to such use, which are essential to understand.

At the dawn of the atomic age, Albert Einstein warned: "The splitting of the atom changed everything, save man's mode of thinking. Thus we drift toward unparalleled catastrophe."

A survey conducted by the Union of Concerned Scientists of 549 physicists in the American Physical Society revealed that physicists oppose SDI by a ratio of nearly two to one. And opposition to SDI was strongest by those who said they were very knowledgeable about it.

Among these scientists, the prominent astronomer Dr. Carl Sagan and his colleagues have also tirelessly attempted to inform the peoples of the world that nuclear war will be vastly different from any conventional war.

NUCLEAR WINTER

A few years ago, Dr. Sagan and his colleagues calculated that the detonation of 100 megatons of nuclear explosive power, targeted on 1,000 cities, could inject enough dust and soot into the sky to initiate a climatic state called "Nuclear Winter"—a wide-ranging, long-term period of darkness and sub-freezing temperatures, accompanied by radiation sickness and starvation, leading to the destruction of civilization as we know it.

Dr. Sagan's study of Nuclear Winter was initiated, to a great extent, by his investigations of the planet Mars. After analyzing the global drop in temperature on Mars during the planet-wide dust storm in the early 1970s, Dr. Sagan and others began to consider the conditions under which a similar effect could be produced on Earth. It was found that natural events, such as the collision of the Earth with a comet or asteroid, or a major volcanic eruption, could inject enough dust into the air to block sunlight sufficiently to produce a noticeable drop in the average global temperature.

It is of greatest importance to note that this so-called "Nuclear Winter" effect, which was apparent and should certainly have been at least qualitatively foreseen by U.S. military planners, had been completely overlooked by everyone involved. And furthermore, this effect is the single most important finding during the past 40 years concerning the effects of nuclear weapons. It must also be mentioned that three other effects whose consequences are of enormous importance in the event of nuclear warfare had also been completely overlooked until they were accidentally discovered. The conclusion is inescapable that man, even the most intelligent of men, does not really understand what he is doing in dealing with such tremendous energies (to say nothing of the resulting radioactivity). He has literally produced a Frankenstein which has the power to destroy him.

DEMONSTRATION

The following demonstration represents the total destructive power of the world's nuclear arsenals at present. For this demonstration, a metal trash can and a number of BBs will be used. 1 BB will represent a 1 megaton bomb. Listen to the sound of the 1 BB as it strikes the bottom of the can. That sound represents the explosion of a 1 megaton bomb. This is the explosive power of about 77 Hiroshima Bombs.

In this small vial, there are 100 BBs. These 100 BBs represent the 100 megaton which have been calculated to initiate a Nuclear Winter over much of the planet. Listen to the sound of the 100 BBs striking the bottom of the can. That sound represents the explosion of 100 1-megaton bombs. this is the power of 7,700 Hiroshima bombs.

At this point consider the following question: How much explosive power do we presently have in the world's nuclear arsenals?

The demonstration will now be concluded by pouring into the can the number of BBs which represent the actual explosive power of the world's present nuclear arsenals. Listen to the sound.

100 megatons of explosive power is all that is seemingly needed to initiate a Nuclear Winter. Poured into the can were a total of 18,000 BBs, representing the 18,000 megatons in the world's nuclear arsenals. This is the power of over 1.2 million Hiroshima Bombs. The two Superpowers to this present date have stockpiled 180 times the explosive power required to induce a Nuclear Winter. And they are both still building nuclear weapons. The U.S. is adding four new nuclear bombs per day to its stockpiles. For the reasons stated above, this number is expected to increase substantially with the development of SDI space weapons.

Everyone can do something to help save our planet. The hope for the future of the entire world lies with you. It is through your efforts that we humans may continue to explore the universe.

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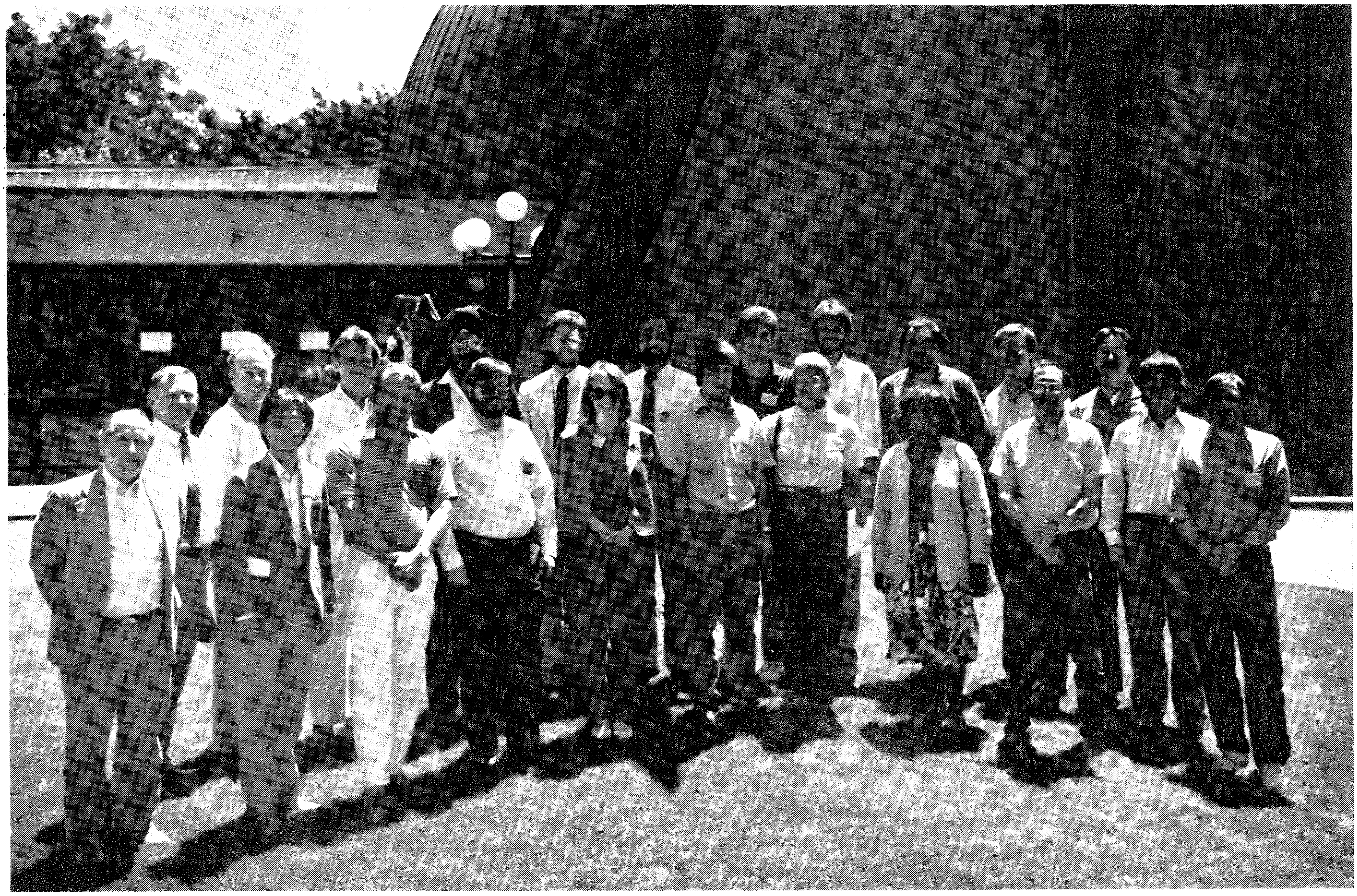


1986 Strasenburgh Production Techniques Seminar

In late June, 1986, just before the IPS Conference in Tucson, the staff of the Strasenburgh Planetarium of the Rochester (New York) Museum and Science Center conducted their seventh biennial Production Techniques Seminar. Fourteen planetarians participated, 10 from the U.S., one from Sweden, one from Australia and two from Singapore. Since its inception, 167 people have taken part in this week-long event which focuses on such planetarium skills as making soundtracks, designing and photographing visuals and creating special effect projectors. Time is built into the intense schedule for a formal presentation by the teacher/staff member, questions and answers, and an exchange of information among the participants and the host staff. Comments on the evaluation form included: "I wish we had come here long ago," "Well planned and organized," "You have raised me to a much higher level of ability, awareness and creativity." It is anticipated that the Seminar will be offered again during the summer of 1988, near the time of the IPS Richmond conference.

Front Row, *from the left: Carl Dziedziech, Strasenburgh Planetarium; Chang Khen Chung, Singapore; Johann Galakin, St. Louis, Missouri: Duane Denham, St. Louis, Missouri: Sally Howard, Australia; Joe Ricci, Strasenburgh; Gloria Rall, Erie, Pennsylvania: Ann Hare, Cleveland, Ohio: Vic Costanzo, Strasenburgh; Dave Lorah, Strasenburgh; Elmer Bataitis, Strasenburgh.*

Second Row, *from the left: Ray Smalley, Cleveland, Ohio; Bill Berry, Imperial, Pennsylvania; Art Klinger, Osceola, Indiana; Bhagwant Singh, Singapore; David Holz, Iola, Wisconsin; Fran Biddy, Strasenburgh; Jay Schwartz, Yonkers, New York; Peter Michaud, Strasenburgh; Bjorn Stenholm, Sweden; David Slonaker, Strasenburgh; and Jim Sweet, Strasenburgh.*

FORUM

With this issue we introduce a new feature: Forum. In ancient Rome, the forum was, among other things, a place of assembly for the discussion of public matters and current questions, and that's what it is here. Each Forum contains one topic and the comments of several planetarians who were invited to react to it. You, the reader, are invited (and encouraged) to agree or disagree and to share your thoughts. Your comments will be printed in the next Forum. Submissions may be edited to conserve space, and short replies are preferred. The deadline for replies is March 1.

The ***Forum*** *begins with a quotation from Allen Grasso that appeared in his article "New Ideas For An Old Planetarium" in* Astronomy, *October 1981:*

"Finally, if someone were just starting out in a small one-person planetarium and asked for some quick advice, I would offer this: Today's planetarium audience prefers to have a live person talking to them, not 'at' them or 'down to' them, but directly to them."

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

The small planetarium lends itself to the personal approach. The relationship established between the lecturer and audience in a small theater is impossible to duplicate in a large theater. It's hard to get personal with 300 strangers in a dark room.

But the quote also offers a challenge. Because of the preconceptions of the individual members of the audience a lecturer has to walk a tightrope between talking "at" them, "down to" them, or directly to them. It's easier to target an audience of 100 than an audience of 300.

Hal Donovan
St. Louis Science Center
St. Louis, Missouri

Someone else said "The greatest special effect in the planetarium is the lecturer!" I would agree. For our school shows we use a live lecturer. Our philosophy is to use a participatory approach. Our seating is limited to 45 (a plus) since we may interact with our school audience. Before turning down the lights and turning on the stars, we have a "name the planet" contest. We pull out models of the planets one by one and hands shoot up. The planets are then set in correct order on a demonstration table for all to see (the children do this). We then go into the star identification part, continuing with a question-answer format when possible. The youngsters participate. They are not lectured at. We get excellent response this way. It makes for a fun learning field trip.

A good planetarium narrator is a happy narrator who enjoys astronomy with his audience.

Charles F. Hagar
San Francisco State University
San Francisco, California

Live shows take a tremendous amount of energy during the delivery. However, audiences attending small planetariums would probably be the type that would enjoy this category of program. The percentage of people attending this type of planetarium would be, I suspect, small.

Here at Chaffee our live sky show was poorly attended in comparison to our non-live shows.

Gary Tomlinson
Chaffee Planetarium
Grand Rapids, Michigan

What you offer for programming is greatly controlled by your audience. Large planetariums certainly have many different audiences. Here at a small facility we have two audiences, school children and the public. It's been my experience that they must each be handled somewhat differently.

We have between eight to twelve school programs available at all times. They are almost all live. And more importantly, they are interactive. I agree, no one likes to be talked "at" or "down to." However, with children I don't talk "to" them as much as I like to talk "with" them. I like to ask them questions. Children get very bored and restless when they are lectured to, even when it is at their level. But kids love to tell you what they know. They are full of questions and their brains work quickly. Although their reasoning often leads them to wrong assumptions, with direction they can usually see their flaws and find their way to the correct conclusions. I think this audience needs the planetarium instructor to challenge them and help them to discover the answers themselves.

The general public, on the other hand, must be dealt with differently. If I were to give a show to the public in the same manner as I would give it to a school group, it simply wouldn't work. The general public is not that interactive. Sure, they may want to ask some questions, but they don't want to be put on the spot. After all, it's Friday night and they could have gone to the movies.

For the public I like to provide as much variety in programming as possible. We depend very heavily on repeat customers. Every show must be new and fresh. From September through June we offer between four to six different public shows. We have to; after six to eight weeks everyone has seen it! I don't think one person could adequately write, produce, and give six new and dynamic live shows each year on top of a full school schedule. If you have the technical capacity a combination of live and taped shows is a healthy mixture for both audiences and planetarian.

Discover your audiences' needs and develop your programs around them. Live shows make for a very strong background if they are done well. Challenge those school groups with questions and activities. Make them think! Don't just give them all the answers. With public programming, stay fresh, offer variety (some live, some taped, some mixed), and keep them guessing about what they're going to see next.

John Meader
Francis Malcolm Planetarium
Easton, Maine

Give your audiences what they want. Don't be afraid of experimenting. Present the type of programming that will maximize the use of your theater.

More than a few of us in the field can recall our first visit to a planetarium. I, as an eleven-year old, was so enchanted with what I saw that I decided at that early age to make a career out of it. The live lecture was superb. Why did it seem so much better then? I was looking through the eyes of a youth, and youth is very impressionable. That is why the live lectures are recalled so fondly.

Today, the good live lecturer is a rare bird and may be going the way of the passenger pigeon. And that is sad. There is still a place for good lecturers. How many of the younger members of our profession have the ability to do a good live lecture? And by good I mean the ability to command an audience as you unravel the mysteries of the heavens. A good lecturer must be a good storyteller. The composer Marc Blitzstein put it this way in his *Airborne Symphony*: "Tell the stories." And that, in a nutshell, is where it's at.

Remember that whether your show is live or canned that you are presenting it in a theater to an audience. Good planetarium has got to be good theater whether live or canned. Good theater drew large audiences 3000 years ago and it still does today. All of the movie special effects in the world couldn't have saved *Star Wars* if it weren't for the human issues that made it good theater. The everlasting battle between good and evil, youth coming of age, and one's acceptance by one's parents. Astronomy, unlike the other sciences, cuts across all of man's experiences on this planet. It offers a wealth of tales to tell to young and old. You don't have to recreate the *Star Wars* saga to present your shows in a compelling manner. Just tell the stories and tell them well.

Arthur Barton
Clyde Tombaugh Space Theater
Alamogordo, New Mexico

I'd emphasize the word "talking." There are so many programs on tape. Of course I use taped programs too. But to have a live person to talk with the audience encourages that audience to be alive, to participate in some manner. I quite agree with the idea of a live person talking with the audience.

Mary Rogers
Wickware Planetarium
Willimantic, Connecticut

[All of the comments in this Forum are from North American planetariums because no one from abroad who was invited to participate did so. —Ed. ❑

Back Issues and Special Reports Are Still Available

A reminder to new IPS members: individual back issues of *The Planetarian* and of the *Special Reports* are available from the Strasenburgh Planetarium. *Special Report #11: The Special Effects Projector Sourcebook* is especially useful. Write to Charlene Oukes, IPS Back Publications Repository, Strasenburgh Planetarium, P.O. Box 1480, Rochester, New York 14603, U.S.A. for ordering information.

Computer Corner

A Simple Laserdisk Control System

Keith Johnson
UALR Planetarium
University of Arkansas
2801 South University Avenue
Little Rock, Arkansas 72204
telephone 501/569-3259
CompuServe 75746,3625

Please welcome Keith Johnson as the new "Computer Corner" editor. In my years as editor of this column I limited myself to reviewing astronomical software, but Keith plans to broaden its scope to include hardware as well. He's beginning by describing a laserdisk control system he developed himself. As laserdisks are becoming quite common, his solution might be useful to others.

There's nothing like a bit of feedback now and then to know that living people do read your column, so if you enjoy what you read here or have ideas to share, please let Keith hear from you. —Editor

Like the rest of *The Planetarian*, "Computer Corner" is undergoing a change of guard. John Mosley did an excellent job of keeping us up to date on microcomputers in astronomy. I'm enthusiastic, if not downright fanatical, about these fascinating machines, and if enthusiasm counts for anything I should be in good shape to take his place.

I am one of those who cannot remember how I got along without my trusty number-cruncher. I enjoy and appreciate commercial software, and will try to keep you informed about new astronomy programs that come out.

I also enjoy writing my own programs and using commercial programs in unusual ways. I telecommunicate, I word-process, I occasionally go adventuring, and I like to take programs apart to see how they do what they do.

Sometimes I go overboard. I used three computers to get this column ready. I originally typed it in on an Apple //e at home. Then I transmitted the text over the phone lines to a Dual Systems minicomputer in our Physics and Astronomy Department. Finally, I downloaded the text into a Macintosh in the office, one rainy day when no one else was using it. There was no reason to take such a roundabout path, but I wanted to see if it could be done with the equipment we have.

The key word for me is "enjoy." Some users look on their machines as fancy typewriters, nothing but tools. Computers are tools, certainly. But the best tools are ones that you can enjoy using. I will be trying to explore some areas of Computerdom that are both useful and pleasurable.

One area I'll be looking at is the usage of computers in unusual ways. Everyone uses her micro as a word processor, a record keeper, and perhaps a fancy calculator (to say nothing of game-playing, and I'd better not in an article my boss might read!). But these little machines have turned out to be so versatile that people have invented uses for them that were never envisioned by their creators.

For example: a recent innovation in visual imaging in the planetarium has been the laser videodisc player. On a single disc a little over a foot...sorry, a couple dozen centimeters in diameter are stored well over ten thousand still television images, plus fifteen or twenty short film clips. Many of us use the astronomy discs published by Optical Data Corporation of Florham Park, New Jersey, in our classes and shows. Some of us use video projectors to spread these beautiful images across our domes. It's not quite OmniMax, but it's way ahead of a slide projector. I'd suggest nicknaming such a system the "MiniMax" if I didn't think it would confuse our statistics classes.

But there are some pitfalls. You're dealing basically with the hightech equivalent of a random-access slide projector, but with many thousands of slides. You must press a series of somewhat cryptic buttons on a crowded control paddle in the proper order to get the correct image up on the dome. You must know the frame number of each slide you desire, and you must spend quite a few seconds "dialing in" the necessary information.

The task is generally tedious and repetitive, so of course someone decided that it should be assigned to either a microcomputer or a graduate student, and the computer is cheaper. Optical Data manufactures an interface and software for the Apple II line to let it do most of the work. Now you can type in a script of cued images, including film clips, using either your word processor or the specialized cue editor supplied by the company. Your images will be shown in order upon the pressing of the proper keys on the Apple keyboard.

The software is quite versatile. You can go forward or back through your script; you can enter additional cues in the middle of the playback; you can adjust the speed of a slow-motion movie clip.

But versatility generally works against ease of use. Veteran computer users should have no troubles, but a complete novice is likely to be a bit confused and mistake-prone. In our institution, I foresaw people wanting to use the system who did not wish to become experts with it: they just wanted to show some pictures!

Another problem: I didn't want to be tied to the computer. One of our carousels has a long control cord, so I can walk around our theater while using it. This would be impossible with a computer, even a laptop, unless you're built like Joe Hopkins.

So I decided to simplify things even further. I wanted to make a hand controller as simple as a slide projector: one button for "Forward," another for "Reverse." The user could just load in his script, and go through the images as though he were punching the buttons for an Ektagraphic. Then I could attach the controller to the end of a long cord.

The easiest way to "punch buttons" on an Apple II is to use the Game I/O ("Input/Output") port, which Apple now prefers to call a "Hand Controller Connector." There are three "push-button" inputs to the computer. I used the first two (Switch 0 and Switch 1) to signal forward and reverse to the Apple.

One problem: the Optical Data interface card itself uses the Game I/O port to transfer information between the computer and laserdisc player. I called Optical Data to check on this, and they graciously told me that only Switch 2 (that is, the third one!) is used by their hardware. I disassembled their machine-language routine to check on this, and Switch 0 and 1 were indeed free for the taking.

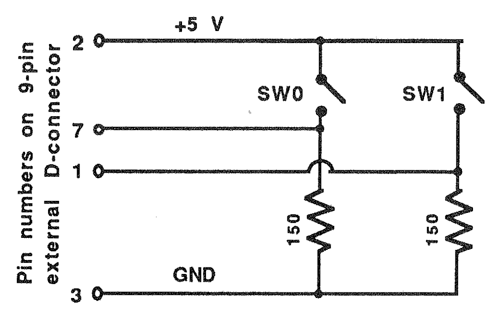
So I built a simple two-button controller that plugs into the back of an Apple //e (the videodisc interface plugs into the internal socket). The details are given in the accompanying schematic. The procedure for constructing the push-button came from several Apple magazines. If you're not inclined to build a dedicated piece of hardware, it's perfectly all right to use your joystick (or "cursor control device," as a friend had to describe it on his purchase requisition). Its two buttons are nearly always connected to Switch 0 and 1.

Notice that this only works with the Apple //e, not the Apple][+. This is because the][+ does not have a 9-pin external socket for a game controller. It has only the old 16-pin internal socket, while the //e has both types. Since the videodisc interface also needs a socket,][+ owners are short one socket. But that can be fixed. There are various adapters available that give you two or more sockets connected in parallel to the Apple internal socket. You then plug the Optical Data interface into one socket, and your joystick or homemade controller into the other.

But not all of these will work. Some types, such as "Paddle-Adapple," only connect some of the pins, and the laserdisc interface will not work with them. All the connections must be split, since the interface uses some outputs that most game devices don't need. Since I generally like to make my own mistakes rather than buying commercial ones, I built myself a splitter that carries everything. So far, we've had no problems with it. If you buy a commercial "splitter," be sure all connections are made, including the annunciators (An-0 and An-2 are both used in the interface).

Now: how do you use the new buttons? I wrote a BASIC program to read them, and advance or reverse depending on which was pressed. I also programmed for the four arrow keys, to serve as a backup in case the hand controller went on the fritz some day. I used a text file of cues, identical to the format used by Optical Data's software. If anyone wants a copy of my program, let me know. The machine-language driver that actually controls the interface is, of course, proprietary software available only from Optical Data Corporation.

One technique I found helpful: I used a "database" program, from AppleWorks, to create the file. I believe the same method could be used to create cue files for Optical Data's software. Such programs allow you to manipulate the information faster and easier than a



Circuit diagram for 2-button videodisc controller word processor. Just be sure your program can store the cues on disk in the form of a text file. Again, for more information on our system, send me a request.

I know that IPS members have discovered other ways to manipulate their marvelous machines in unexpected ways. I'd like to hear from anyone who has an interesting tale to relate about her microcomputer. Some of you are involved in electronic astronomy bulletin boards. Some of you use your computers to run your magic star machines. Some astronomers, both amateur and professional, press their micros into service as telescope-control devices and data-takers. What are YOU doing? Does your computer answer your phone? Are you logged onto the educational network BITNET? Does your computer write your shows for you? Have you come across an obscure piece of software that has given you joy? Do you track earth satellites with your light pen? If so, let me know, and I'll share it with everyone else. Drop me a line, either electronically or on old-fashioned paper. Don't make it a finished article; just a few sentences is fine and I'll do the rest ❑

The V.M. Slipher Committee of the National Academy of Sciences Announces Funds Available in 1987 for the Improvement of Public Education in Astronomy

During 1987-88, the V.M. Slipher Committee will have a modest amount of funds ($4,500) to award for projects that enhance the public's understanding of astronomy. Preferences will be given to projects requiring seed money for programs that will continue beyond the funding period. The committee does not wish to limit the amount requested, but proposals for more than $1,000 will need to be especially deserving to receive full funding. Past grants have included support for radio programs on astronomy, refurbishment of a historical telescope for use in a public museum, partial support of teacher workshops and park interpretive workshops.

If you wish to submit a proposal to the V.M. Slipher Committee, please note the following criteria:

1. The objectives and procedures to be followed in the project should be outlined in concise terms.

2. The budget page should identify how funds will be spent (please note any other funds allocated to this project, both direct and in-kind).

3. Proposals should be short—no longer than three typewritten pages.

4. Applications must be postmarked by May 25, 1987. Notification of grants will be made around July 15th.

Please send applications to:

Dennis Schatz, Chairman
V.M. Slipher Committee
Pacific Science Center
200 Second Avenue North
Seattle, Washington 98109

Planetarium Usage for Secondary Students

Gerald L. Mallon, Ed.D.
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Norristown, Pennsylvania 19403

INTRODUCTION

In an earlier issue (Mallon, 1983), I mentioned that the purpose of this column was to serve as a tool for communication among the vast number of planetariums which serve school populations. The column would function as a forum for the sharing of lesson ideas that apply to students in grades 7–12. Students at this level may or may not study astronomy as a specific subject, but they can be included in planetarium programming, by involving them in lessons that stress an interdisciplinary approach to education, combining astronomy with other subject areas. Throughout the field, there have been many exciting lessons that have been created in this manner, and all represent many hours of work on the part of the planetarium directors to research and develop the ideas. This column then, offers a vehicle for the sharing of these ideas, and allows us as professionals to learn and grow from each other's work. It becomes possible for us to examine someone else's ideas, and to adapt such lessons that are appropriate to our particular situation, without having to invest all of the time and energy that was required to originally develop the programs. Of special note, it makes available "tried and true" programs, that is, planetarium programs that have been implemented, evaluated, and revised by other professionals, before being presented for our consideration.

I am restating this position now for two reasons. The first reason is simple: "No Lessons = No Column." It is crucial to the continuation of this column that people submit their planetarium lessons for publication. It is clear that many fantastic lessons exist out there, but unfortunately some of us are "keeping our light under a bushel basket." As professionals, we need to acknowledge our responsibility to do what we can to improve our profession and to help our colleagues. Submitting a manuscript for publication is just one method of demonstrating our commitment to the profession. It permits others to benefit from our individual work and thereby benefits the whole profession.

The second reason involves the particular lesson being presented in this issue. This program offers a concrete example of how an idea for a lesson can be adapted, evaluated and revised to meet the needs of a particular population. The ideas or methods included in this program may not be "original" but they were selected, ordered, and presented in this manner, so as to meet the needs of a specific group. This lesson would not exist if it were not for the work of other professionals, who took it upon themselves to share their ideas, and thus offer me the opportunity to utilize their work for the benefit of my students. It is being offered here as an example of a lesson that has been presented and refined over many years of use, and has proven to be a successful lesson for secondary math students. Perhaps, others may examine it, and find that it has some value to them in their own planetariums.

The genesis for the program is as follows. The math teachers from the high school in my school district were interested in bringing their classes to the planetarium for a lesson that would emphasize how geometric concepts could be "put to use" in a particular field. They wanted a lesson that: included as many relevant geometric topics as possible, directly involved the students in the lab exercises, and could be accomplished in one hour (or less). To accommodate these demands, I researched three different lessons, each of which could have been the basis for an individual program, and extracted the main points from each to create "Geometry Exercises in the Planetarium." This lesson examines three types of measurement: 1) The size of an object (circumference of the earth), 2) The distance to an object (stellar parallax), 3) The amount of objects in a given area (random sampling). Over the years, various methods of presentation have been tried, until finally the current combination evolved. It has been used in the Methacton School District in one manner or another for the last 12 years. I would personally like to thank Hu Harber (Harber, 1971) and Art Young (Young, 1972) for publishing their ideas on this topic so that I could gain from them. I hope that this presentation can carry on that tradition.

Readers are reminded to please send any comments on this lesson, as well as submissions of other lesson plans for the secondary level (grades 7–12) to me. In submitting lesson plans, please remember to use the following format: Title, Purpose, Objectives, Materials, Preparation, and Procedure. Thank you

(continued from previous page)

Geometry Exercises in the Planetarium

A Planetarium Lesson
by Gerald L. Mallon, Ed.D.

PURPOSE: To explore the practical uses of geometry by examining its application to the study of astronomy. In particular, the lesson will examine three types of measurement: the Size of an object, the Distance to an object and the Amount of objects.

BEHAVIORAL OBJECTIVES: By the end of the lesson, the students should be able to: 1. set up a proportion to solve for the circumference of the earth, given the distance and angular difference between two appropriate cities. 2. determine the distance to an object by using the angle of parallax and the baseline between two observing points. 3. explain the purpose of random sampling and some of the requirements involved in the process. 4. estimate the number of stars produced by a planetarium projector given at least 100 random samples from which to work.

MATERIALS: Worksheets (see samples), slides, geo-earth projector, 4 astrolabes, protractors (one per student), toilet paper tubes (one per student), calculator, drawing boards, 2 small tables, 4 straight pins (at least).

PREPARATION: All projectors and worksheets should be ready for use. The toilet paper tubes (astronomical viewing devices—ASD) should be kept aside in a box until needed. The astrolabes should be constructed prior to the lesson and along with the protractors, should be kept aside until needed. (For an explanation of how to construct a simple astrolabe, see the previous issue of the Planetarian [Mallon, 1986]. The math teachers may wish to offer a classroom lesson on the function and/or construction of the astrolabe prior to the planetarium lesson.)

Lab Exercise A—The planetarium should be set with the sun on Sept. 1, and the latitude at 9°N. The Geo-Earth projector should be set with Colon, Panama on the Zenith.

Lab Exercise B—Moon should be full and positioned on the meridian at about 20° in altitude.

Lab Exercise C—Planetarium should be set for current sky and latitude.

PROCEDURE: Explain the purpose of the lesson to the students. Stress the laboratory nature of the work and the need for their cooperation and participation. Answer any questions that students may have about the nature of the planetarium, before beginning the lab exercises. Distribute workbooks.

LABORATORY EXERCISE A—"Determining the Circumference of the Earth": Introduce the story of Eratosthenes and his method for determining the size of the earth. Ask students to set up a proportion using the information provided in the diagram on their worksheets (see worksheet). (Either of the following proportions will work: <s°/360° = AB/Circumference or <s°/AB = 360°/Circumference.)

Explain that because of the parallel nature of the light rays from the sun, the angle between the two cities can be derived by determining the angle of the sun from the zenith (when two parallel lines are intersected by a third line, the alternate interior angles are equal). Next, use the student derived proportion to solve for the circumference of the earth. Explain that instead of using the cities described in the Eratosthenes problem, they will be using cities closer to home, cities that lie in the western hemisphere. Using the geo-earth projector, and the planetarium projector, demonstrate the sun at the zenith for Colon, Panama at 9°N latitude for Sept. 1. Point out that directly north of Colon is the city of West Palm Beach, Florida. State that the sun would not be on the zenith for that city. Turn off the geo-earth projector and reset the planetarium projector for the latitude of West Palm Beach (26°N). Pick eight volunteers from the class to use the astrolabes to measure the altitude of the sun above the southern horizon. To accomplish this, the students should work in pairs. One student should look through the viewing tube on the astrolabe, while the other student looks at the position of the string on the scale. Because of the unique nature of working with a projection of the sky, the students should stand directly next to the planetarium instrument, in line with the center of the machine, rather than in front of, or behind the machine. Average the four measurements (it should be 73°). Students should then determine the angle of the sun to the zenith by subtracting the observed angle from 90° and then using this figure, along with the distance between the two cities (1,180 miles), to solve the circumference of the earth.

$$\text{Circumference} = \frac{1180\text{ mi.} \times 360^{\circ}}{17^{\circ}}$$

$$= 24{,}988 \text{ miles}$$

(Note: Before this current method of presentation was developed, two other methods were tried. In the first, students used sextants to measure the angle of the sun. [Hu Harber has developed a correction table that permits the use of sextants to measure angles in the planetarium {Harber, 1977}.] However, it took an inordinate amount of time for students to learn how to use the sextants, before they could make the measurement, and since only a few were actually using them, the rest of the students became very restless. As a result of this experience, I tried simply projecting the meridian onto the dome so that the students could determine the altitude of the sun along the meridian. This method was successful in allowing the students to find the angle in a short amount of time, but met with disapproval from the math teachers. They felt that this method did not offer enough student participation. The students were not discovering how such an angle could be measured; they were simply using the angle to solve the problem. Thus the current method involving the astrolabes developed. The students see how an angle can be measured but the amount of time necessary to accomplish the task is considerably less than when using the sextants.)

LABORATORY EXERCISE B—"Determining Distance Through Parallax": Through a series of slides, students are introduced to the problem of trying to determine the distance to objects. Starting with distances that can be directly measured, students come to consider the problem of distances to objects beyond "reach" such as the stars. The concept of parallax is presented and students are asked to see the effect by alternately looking at their thumb (held about 30 cm in front of their nose) from one eye,and then the other. Knowledge of parallax is not new; the ancient astronomers knew of this concept and they realized that if the earth moved, then the stars should shift. Since they could detect no change in the positions of the stars, they logically concluded that the earth must be standing still! Students are asked to consider why the ancient astronomers did not see a change in the star positions. (The stars are so distant that the change can not be detected by the human eye.) It was not until 1838 that the German astronomer Bessel made the first reliable measurement of a stellar parallax and thereby provided evidence of the earth's orbit around the sun. Additional slides (including actual photographs of stellar parallax) are used to show how a closer star would appear to move in relation to the background of stars when seen from two opposite points in the earth's orbit.

Before attempting to determine the distance to an object, students are introduced to the "Skinny Triangle" formula which has special relevance to stellar distances. Using their worksheets, students first determine the proportion between the factors presented, and then use the following formula for determining the distance to an object.

$$r = \frac{360^\circ \times AB}{2\pi \angle P^\circ}$$

Students are next introduced to a problem in the planetarium. They will attempt to determine the distance from a baseline in the back of the room, to a projection of the moon on the dome. It is explained that this particular incidence is not a "Skinny Triangle." The angle of parallax that will be found will actually be many degrees whereas in the case of stellar parallax, the angles are only fractions of degrees. However, this exercise will help them to visualize how the process works. They will actually be able to "see" the triangle that is created by the two tables and the projection of the moon.

The process for determining angle P is explained. Two tables in the back of the planetarium will be used as "observatories" for sighting the moon and determining the angle from the baseline to the moon. Teams of 3 or 4 students will work at each table. Drawing boards are placed on the tables along with a few straight pins. The boards each have a sheet of paper attached to them and are set up such that the baseline runs between the tables. (You may wish to actually run a string between the two tables to demonstrate the baseline.) Students place a pin in the drawing board directly on the baseline. They sight from this pin to the moon, and place a second pin in line with this path. This creates an angle from the moon to the baseline for each of the two tables. These two angles will then be added and the sum subtracted from 180° to determine the angle of parallax. (See worksheet for diagram and more detail.) Using the information provided, (in the Methacton Planetarium, distance AB = 7 meters and angle P = 44°) students complete the equation to determine the distance to the planetarium moon. This figure is then compared with the actual distance (which in my case was determined before the students arrived, by stretching a string from the baseline in the back of the planetarium to the moon on the dome, and then measuring the length of the string. The actual distance is 8.9 meters and using the information provided, and the skinny triangle formula, students usually reach an estimation of 9.1 meters.) After this exercise, the student workbook includes a page on some of the units of measurement used in astronomy. This page, and its explanations of light years and parsecs, can either be presented to the class as part of the lesson, or assigned as homework.

(Note: After many years of presenting this exercise, I have found that in some classes, it becomes necessary to simply provide the angle of parallax, after describing the method for finding it, rather than actually having the students determine it. Many factors go into selecting the proper route to follow for each particular class. All of the materials are set up in the planetarium for the complete lab, but the judgement of whether to present it, in its entirety, depends on: student behavior, academic background, level of cooperation and participation, the amount of time left in the class period, etc. The level of student participation in this lab exercise then, varies from class to class. By adjusting the length of the presentation for this exercise, it becomes the "buffer zone" that permits sufficient time for the completion of the other two lab exercises that make up the total lesson.)

LABORATORY EXERCISE C—"Determining Stellar Populations." Students are introduced to the topic of star counting as outlined in the first section of the worksheets for this lab exercise (see worksheet). Next, students discuss the difficulties in determining the total amount of items when dealing with very large populations (no one wants every drop of their blood to be drained to determine a red or white blood cell count!). Students are then guided in a discussion of sampling techniques and the need for random sampling in certain situations (uneven distribution). After this brief overview, the students are confronted with the problem of determining the total number of stars that are projected by the planetarium instrument. The major parts of the problem are briefly explained:

1) random samples of the starfield must be taken.
2) the average number of stars per sample must be found.
3) the area of the sample must be determined.
4) the total area must be determined.
5) The number of samples necessary to fill the total area must be calculated.
6) By multiplying the average number of stars per sample by the number of sample areas it would take to fill the total area, the estimated total number of stars can be found.

Students begin by taking one of the cardboard tubes (astronomical viewing device—ASD) and making four random samples of the night sky. The total for their four counts is placed on a slip of paper and turned in. A few volunteers from the class add all of the counts and find the class average for the number of stars seen per sample area. While this task is proceeding, the majority of the class attempts to work through the remainder of the steps. First, they must determine the size of the sample area, in square degrees. Using a scale drawing of the ASD on their worksheets, students use their protractors to find the angular diameter of the sample (20°) and then use this figure in the following formula to find the area:

$$\text{Area of circle} = \pi r^2$$

$$T = \pi(d°/2)^2$$
$$= 3.14\ (20°/2)^2$$
$$= 3.14 \text{ square degrees}$$

Next students must determine the entire area of the celestial sphere, in square degrees. Beginning with the formula for the area of a sphere (Area = $4\pi r^2$), they must find the radius in degrees. This can be determined by using the formula for circumference of a circle and solving for r. (see below)

$$\text{Circumference} = 2\pi r$$
$$360 = 2\pi r$$
$$r = 360°/2\pi$$
$$r = 180°/\pi$$

Using this figure for r, the students find the total area of the sphere to be 41,253 square degrees. It is a simple step to now find the number of samples areas it would take to fill the total sphere (divide 41,253 square degrees by 314 square degrees = 131). Once this figure is determined, students can then make their estimate for the total number of stars projected by the planetarium by multiplying the average number of stars per sample, by the number of samples necessary to fill the total sphere. The final step of the lab exercise asks the students to determine their percentage of error by comparing their estimate with the actual number of stars projected. (My Spitz 512 projects 1354 stars. Classes usually come very close in their estimates; the closest has been 1350.)

(Note: Over the years, I have tried presenting this lesson many different ways since I first became aware of it in 1971 [Harber, 1971]. I've tried having the students make their own scale drawings of the tubes [too time consuming for the amount of time available]. I've tried simply giving them the magic number of 131, the number of samples necessary to fill the sphere [this method was fast, but it cut out most of the geometric concepts that the teachers were interested in having their students study]. The method described in this article appears to be the best hybrid for my current situation.)

CONCLUSION: The lesson ends by summarizing the three lab exercises and the student results that we found for each. Students are reminded that these are just a few examples of how geometry has a very important place in the study of astronomy. They are urged to think of examples in other fields, where basic geometric concepts play an integral role.

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GEOMETRY PLANETARIUM LABORATORY EXERCISE 1

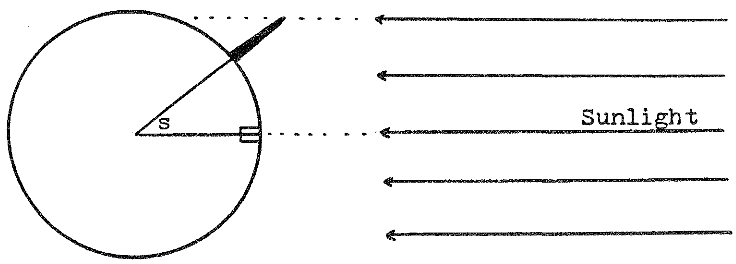
NAME: ______________________ DATE: ______________________

EXERCISE A

Determining the Circumference of the Earth

Eratosthenes, an ancient Greek geographer, living in about 200 B.C. came up with a method for determining the circumference of the earth based on the angles of sunlight received in different cities on the same day.

Below is a drawing of the situation. Examine the drawing and determine the relationship between the angles, the distance between the cities, the circumference of the earth, etc.? (Hint: attempt to set up a proportion using the following: Angle S, Distance AB, Circumference of Earth, 360°)



Your Response:

Next, using the proportion that you developed above and the information gathered in the planetarium exercise, calculate the circumference of the earth.

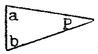
EXERCISE B

Determining Distance Through Parallax

The parallax effect is the apparent motion of a distant object with respect to background objects, due to a motion of the observer. (If you've never noticed this, try the following: Close one eye and with the open eye look at your thumb held about 30 cm. in front of your nose. Next, keeping your thumb still, alternately look at it with one eye and then the other. Your thumb will appear to move back and forth.) The ancient astronomers realized that a motion of the earth around the sun should make the apparent positions of the stars change. Because they could detect no variations in the position of the stars, they logically concluded that the earth stood still. (Why didn't they see a change?) It was not until 1838 that the German astronomer Bessel made the first reliable measurement of a stellar parallax and thereby provided evidence of the earth's orbit around the sun.

Using basic geometric concepts, angle P (the parallax angle) can be determined without the necessity of actually measuring it. How ?? In the example below, determine angle P.

Figure 1.

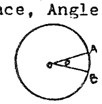


a= 40
b= 70

P= ________

Because the stars are so very distant from the earth, and the baseline so very small in comparison, this "skinny" triangle can provide a simplified method for determining the distance to an object. Consider a circle of radius r, as shown in figure 2. Point A and Point B are two positions that are close together on the circumference of the circle. Angle P is the separation between A and B as seen from the center position o. The arc $\widehat{AB}$ is dependent upon the angle P. As angle P gets larger, arc $\widehat{AB}$ gets larger. Considering this information, determine the relationship between the following factors: Circumference, Angle P, 360^o, Arc $\widehat{AB}$

Figure 2.

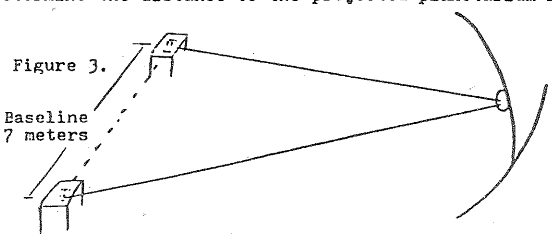


If angle P is extremely small, the arc length between A and B will be approximately the same as the chord length between A and B. This is the case for the stars, and allows us to determine their distance by solving for the radius of the circle using the following equation.

$$r = \frac{360^o \times \widehat{AB}}{2\pi P}$$

Using the information provided in the planetarium exercise, and the above equation, determine the distance to the projected planetarium moon. (See figure 3.)

Figure 3.



Baseline
7 meters

EXERCISE C

Determining Stellar Populations

Star Counting as a method to detect the nature of our stellar neighborhood was first suggested by Thomas Wright in "An Original Theory of the Universe" published in 1750. The same hypothesis was put forth by the great philosopher Immanuel Kant five years later. The argument was that the greater the volume of space that we survey, the more stars we should find. They should be roughly proportional to the cube of the distance to which we look. If they begin to thin out in certain directions, but not in others, then this will provide a clue to the shape of the sea of stars in which we find ourselves embedded.

William Herschel, an English astronomer, was the first to collect some data along the lines of the above suggestions. Herschel counted stars in 683 selected regions of the sky. In some fields he saw only a single star, in other areas he counted up to 600 stars. Herschel concluded that the sun was centered inside a great disc-shaped stellar system. He was approximately correct about the shape of the galaxy, but wrong of course, about the proper position of the sun.

The purpose of this lab is to experience a star counting exercise similar to Herschel's, and to examine methods for determining the total number of objects, when the amount is large and not evenly distributed.

1. **Using your "Astronomical Sampling Device" (ASD) take four samples of the night sky and count the number of stars in each sample. Record your data below and determine the total number of stars seen, for all four counts. Place this number on the paper provided in the planetarium and turn it in so that the average count for the entire class can be determined.**

   A.________ B.________ C.________ D.________ TOTAL COUNT ________

2. **Determine the area of the sample by examining the scale drawing of the "ASD" shown below and using the formula for the area of a circle. The area will be found in "Square Degrees."**

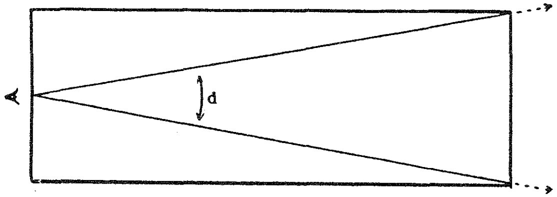
$$\text{Area of Circle} = \pi r^2$$

$$**T = \pi\left(\frac{*d}{2}\right)^2$$

$$= 3.14\left(\frac{\quad ^o}{2}\right)^2$$

$$= \underline{\qquad\qquad}$$

***d = diameter of circle in <u>degrees</u>.**
****T = Area of Circle in "Square Degrees."**



3. Determine the area of the entire Celestial Sphere (in square degrees) by using the formula for the area of a sphere.

$$\text{Area of Sphere} = 4\pi r^2$$

To solve the above problem, you must determine the value of "r" (radius) but the measurement needs to be in degrees. This can be ascertained if you examine the formula for the circumference of a circle. Using the formula below, determine "r" in degrees and then solve the equation for the Area of the Sphere.

$$\text{Circumference} = 2\pi r$$

$$360^\circ = 2\pi r$$

4. Once you have determined the total Area of the Celestial Sphere and the Area of the Sample, you can determine how many samples it would take to fill the sphere by dividing the Area of the Sphere by the Area of the Sample.

$$\frac{\text{Area of Celestial Sphere}}{\text{Area of Sample}} \quad \_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_$$

5. To determine your estimate for the total number of stars, you must multiply the average sample of stars (________) by the number of samples needed to fill the whole sphere (_________). This figure would be the estimated total number of stars visible.

ESTIMATED TOTAL NUMBER OF STARS??? = ________________.

6. Finally, calculate the percentage of error by the following equation.

$$\%\ \text{error} = \frac{\text{actual} - \text{estimate}}{\text{actual}}$$

PARALLAX AND PARSECS

(Stellar Distances)

In astronomy, various units of measurement are used to denote distances. A "Light Year" (L.Y.) represents the distance that light would travel in a year (approximately 6 trillion miles). An "Astronomical Unit" (A.U.) represents the average distance from the Earth to the sun. A Parsec (P.C.) is the distance at which a star has a parallax equal to 1" (one second) of arc.

The word PARSEC is a contraction of the words "PARallax of one SECond." The example below shows that a parsec is equivalent to a distance of 206,265 A.U. (or 3.26 light years).

$$r = \frac{{}^*360^\circ}{2\pi} \times \frac{AB}{P}$$

$$= \frac{1{,}296{,}000''}{2\pi} \times \frac{1\ \text{A.U.}}{1''}$$

$$= 206{,}265'' \times \frac{1\ \text{A.U.}}{1''} \qquad ({}^*360^\circ = 1{,}296{,}000'')$$

$$= 206{,}265\ \text{A.U.}$$

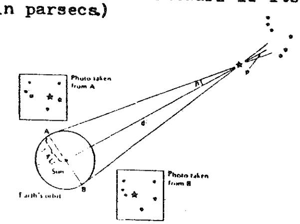
A star with a parallax of 1" is 1 parsec away. How far away would a star be if its parallax were equal to 1/2", 1/3", or 1/4" of arc? The long thin triangle would have to be 2 times as long to have a parallax of 1/2", 3 times as long to have a parallax of 1/3", and 4 times as long to have a parallax of 1/4" of arc. An inverse relationship exists between the distance D of a star, measured in parsecs, and its parallax angle, measured in seconds of arc.

$$\text{Distance (pc)} = \frac{1}{P\ (''\ \text{of arc})}$$

PROBLEMS

1. If Sirius, the brightest star in the night sky, has a parallax of 0.373, what is the distance to Sirius in parsecs?

2. The closest star in the sky (aside from the sun) is Proxima Centauri. What is the distance to Proxima Centauri if its parallax is 0.76"? (Give your answer in parsecs.)



PLANETARIUM LIFELINE

The Origin & Evolution of the Planetarium and Planetarians

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Phillip Fox and the Adler Planetarium

Eyeglasses were invented about 1275; the telescope in 1608; observing areas have existed since the beginning of time. But the planetarium came much later—in 1919. There were a number of forerunners of the first planetarium however.

Astronomical clocks have been around virtually as long as civilization. Stonehenge was an elaborate astronomical clock. The earliest mechanical planetarium came in the late 14th century; then came the orrery in 1682, named for Charles Boyle, the fourth Earl of Orrery. After those we have some more modern devices.

In 1905, Oscar Von Miller of the Deutches Museum in Munich decided to add a planetary machine to the museum. Working with Franz Meyer of Carl Zeiss Optics, and with Max Wolf, an astronomer and director of the Borden Observatory, Von Miller developed the concept of a large hollow globe with many holes and external lights. To observe, one would enter the globe. In 1912, the Chicago Academy of Sciences built a 15-foot hollow globe made of sheet iron, with 692 holes, and with phosphorescent paint for comets and nebulae. This was known as the Atwood Sphere, and it is still at the Academy. It is the intention of the Academy to refurbish it to return it to operation.

Meanwhile, the Carl Zeiss Company financed the completion of a sophisticated projection planetarium system known as the Zeiss Mark I. It was demonstrated to specialists in the field, at the Zeiss factory in August 1923 using a 16-meter hemispherical concrete dome. Officials at the Deutches Museum were quite impressed with it and developed a 9.8 meter dome for this prototype. The Zeiss I was re-installed in the smaller dome of the Deutches Museum in September 1923, and opened to the public on October 21, 1923. This made Oscar Von Miller the first "Planetarium Director" in the world with regard to this more modern type of projection planetarium.

Less than a year passed when Carl Zeiss engineer, Walther Villiger suggested a new, improved Zeiss planetarium projector. This new Zeiss, known as the Mark II, was designed for much larger theatres—up to 23 meters.

The Zeiss II was an immediate success. Within two years 6 other cities besides Munich and the Hague had planetariums (all within Germany). The following year, 1927, found 3 more European cities, including Vienna, with Zeiss II projector theatres. In 1928, three additional cities, including Rome, had a Zeiss II.

The United States did not get its first planetarium until 1930. The Adler Planetarium was opened in Chicago in May 1930 using a Zeiss II projector. The first director of the Adler Planetarium was Phillip Fox.

The planetarium was a result of a gift to the people of Chicago from Max Adler. Adler had traveled throughout Europe and was most impressed with the planetarium theatres he saw there. Upon his retirement as Vice-President of Sears, he decided to give a gift of a planetarium to Chicago, "to contribute to the popular knowledge of astronomy," as he was quoted. Originally, the planetarium was estimated to cost $600,000. However, upon final completion at opening day, the amount spent was closer to $1 million.

When it first opened, its hours of operation were 10 am to 10 pm daily all year round. Planetarium lectures were Monday through Friday, 11 am, 3 pm and 8 pm. On Saturday they were at 11 am, 2 pm, and 3 pm. Sundays the presentations were at 3 pm and 4 pm. Each demonstration was 50 minutes long.

The planetarium held 500 visitors on moveable seats. The dome was covered with white linen. Dr. Fox did many of the lecture demonstrations himself, and he used an optical light as a pointer, since he could not reach the surface of the 21-meter dome to point out objects.

During the first few weeks of operation, attendance averaged some 18,000 to 20,000 per week! Admission was free on Wednesday, Saturday, and Sunday, and the rest of the week it cost 25 cents.

Phillip Fox was an artist, scholar, writer, musician, soldier, and scientist. He was born in Manhattan, Kansas on March 7, 1878. By the time he was 19, he had earned a bachelor's degree in mathematics at Kansas State Agricultural College.

Fox enlisted as a private in the U.S. Army in 1898 at the start of the Spanish-American War, and so distinguished himself in the Philippines that when he left the Army in 1899, he was a second lieutenant.

He began teaching math at a military school in Kansas in 1899 while pursuing graduate studies at Kansas State College; he earned a master's degree there in 1901. At the urging of his cousin, physics professor Ernest Fox Nichols of Dartmouth College, Fox earned a second bachelor's degree—in physics—while attending Dartmouth. Fox was appointed assistant astronomer at he Yerkes Observatory by the noted astronomer E. Hale, and he served there from 1903 to 1905. Fox did further study in astronomy at the University of Berlin in 1905 and 1906, and later earned a Ph.D. in astronomy from the University of Chicago while he was working as an instructor of astrophysics there.

He met and fell in love with a young woman from Chicago, Ethel Snow. They were married in August 1905, and during their nearly forty years together they raised four children: Steve, Bertram, Gertrude, and Robert. Steve went into the steel business; Bertram became an economics professor; Gertrude and Robert were both physicians.

In 1909 Dr. Fox joined the faculty of the astronomy department at Northwestern University in Chicago. Over the next twenty years, he served as Director of the Dearborn Observatory and for the last few years he was the Chairman of the Department of Astronomy. He wrote books on stellar physics and stellar spectroscopy during that time, and also served as the secretary of the Astronomy Section of the American Association for the Advancement of Science (AAAS).

During the First World War, Fox rejoined the Army. He was commissioned a major of infantry in 1917 while in France, and later was promoted to Lt. Colonel and served as the assistant chief of staff of the 7th Division.

Fox remained in the Army Reserve and at the time of his appointment as Director of the Adler Planetarium, he was a Colonel and served as the Commander of the 43rd Infantry of the 86th Division based at Jefferson Barracks, Missouri.

On May 28, 1929, a year before its doors opened, and while it was still under construction, the new Adler Planetarium acquired its first director, selected by Max Adler himself. It was Professor Phillip Fox. He was selected as the acting director, and in doing so, Fox took a one year leave of absence from Northwestern University to serve in this new capacity.

Over the next year, Dr. Fox threw his entire energy into the preparations for the opening of the United States' first planetarium. He traveled to Europe twice, one time for a period of two months, to get ideas that would help him to found a high quality planetarium. In addition, during his travels he spent time looking for supplies, materials, and equipment to augment the planetarium. He wanted a really good science museum to be part of the Adler Planetarium. Fox spent time in England, France, and Germany, and was able to acquire a number of items such as astrolabes, sundials, and the like, to use in programming and for display in the new science complex.

Upon its opening, Dr. Fox decided to present a series of 50 lecture-demonstrations to the public. He did many of them himself, lecturing virtually each day to capacity crowds. A newspaper reporter, giving his impression after having observed Dr. Fox in command of the planetarium, reminded him of the "Joshua" of old. Dr. Fox literally "jazzed up" the universe for all to enjoy.

Even Colonel Dr. Professor Fox, an astute astronomer and veteran of two wars, was most impressed with the concept of such a great planetarium facility. He said, "For years I have been a close student of astronomy and I did not realize it was possible to produce such a remarkable duplication of the heavens as I saw them in the operation of the planetarium at Jena. I lost all sense of being in an enclosure as the stars were projected on the great dome of the building.

"The aspects of the sky are seen from different stations on the earth by regulation of the instruments. The increasing elevation of the pole star as one travels north is readily revealed. By another adjustment, the precession of the equinoxes is shown and one sees the skies as they appeared to Hipparchus, who discovered and evaluated precession."

The purpose of the planetarium, and especially of the Adler Planetarium, was described by Dr. Fox: "If we can bring people to realize better than they have before that the whole cosmos is ruled by law, that it is orderly, that it is a unit, then the planetarium will perform a much desired purpose," he said.

Fox further commented, saying, "We hope that the planetarium, in short, will result in more law and order in mundane, earthly affairs. And we hope, too, that it will help to show that there should be no cleavage between individuals, nations, and races."

After serving many years as Director of the Dearborn Observatory, he made this noteworthy comment, "At the Dearborn Observatory I noticed on 'public nights' that the majority of interested visitors were children and elderly people. Probably there are reasons for that. Children always are interested in the heavens; their minds are forever groping about them. In middle life people are occupied with their daily affairs. But old folk, again, turn to contemplation, and contemplation of the heavens; they have more leisure to think.

"People think that astronomy is a 'useless science,' but a planetarium is just as valuable to mankind as the art institute or the civic opera."

"I believe, though, that here at the planetarium all ages will wish to come; I believe that we will have a good cross section of the population...."

Dr. Fox was concerned about the growth of the large cities and the brightening of the natural skies as a result of population increase. He said, "In the modern city, with its smoke and its night sky with artificial light, there is scant opportunity to see the greatest of natural wonders, the starry heavens. The planetarium is a splendidly successful achievement for the renewal of this knowledge among city dwellers."

And, finally, commenting on the importance of the planetarium, Fox related, "Every arrangement of the heavenly bodies that has been visible on the earth since Noah sailed the ark can be reproduced by the planetarium. People think that astronomy is a 'useless science,' but a planetarium is just as valuable to mankind as the art institute or the civic opera. We are dependent upon the sun for all our food and energy. We will eventually learn to store the sun's heat as we now store ice." How true he was over 50 years ago.

His planetarium philosophy was simple: make each planetarium presentation self-contained, and make it so the program can reach everyone attending the planetarium that day. In reality, his philosophy is not markedly different from the ideas of most of today's planetarium directors.

Phillip Fox served nearly eight years as director. He left the Adler Planetarium on May 1, 1937 to assume the directorship of Chicago's new Museum of Science and Industry, and remained there until 1942.

With the Second World War looming, Fox accepted a commission as a Colonel in the Army in March 1941 and served as commander of the Gulf Coast Recreation Areas. In May 1942 he was appointed commandant of the Army Signal Corps at Harvard University; in September 1942 he became commandant of the Army Electronics Center at Harvard. In September 1943, he retired from active duty in the Army, but he remained at Harvard as a lecturer in electronics. Colonel Dr. Phillip Fox suffered a cerebral hemorrhage and died at Harvard on July 21, 1944, at the age of 66. A funeral was held for him at the Chapel at Harvard in Cambridge, and his ashes were interred in his family plot in Manhattan, Kansas.

The directors of the Adler following Fox's departure include: Maude Bennot, (1937-1945), F. Wagner Schlesinger (1945-1957), Albert Schatzel (1957-1959), Robert Johnson (1960-1966), and finally, Joseph Chamberlain (1968-), who attended Columbia University.

It is interesting to note that Maude Bennot served as acting director of the planetarium. She was never appointed director. Also, there was a period of six months after Albert Schatzel left office that there was no director. In addition, for the year and a half after Robert Johnson left the job, Mort Kaplo served as the head of the planetarium, even though he was not the director, nor the acting director; he was merely the most senior staff member.

Many staff members of the Adler Planetarium learned skills to prepare themselves to become leaders in the planetarium field elsewhere; two examples are Dr. Lee Simon, who went on to direct the Morrison Planetarium in San Francisco; and Dr. Lee Shapiro who became the head of the Morehead Planetarium at the University of North Carolina in Chapel Hill.

The Adler Planetarium is located in Chicago on Lake Michigan and is an imposing place. It has a Zeiss VI that was installed in 1970. Its dome is 20.7 meters in diameter and it now has 392 permanent seats. It is open daily from 9:30 am until 4:30 pm, and on Friday evenings its Public Observatory is open. It presents sixteen regular public shows and fifteen school shows each week during the school year. During the summer, there are thirty-six public shows per week. The Adler also has an extensive science museum. The current director is Joseph Chamberlain.

Many thanks to James Sweitzer and Joseph Chamberlain of the Adler Planetarium, and John Allsites of the Chicago Astronomical Society for helping with this article. ❑

The Universe at Your Fingertips: Astronomy Resources

Andrew Fraknoi
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AN INTRODUCTION TO THE A.S.P.

Initiated at the kind invitation of your editor, this column is planned as a report on the current activities of the Astronomical Society of the Pacific, as well as an exploration of some of the resources and tools available for planetarium educators. I hope to review new materials that you may not be familiar with or older tools that may have escaped your attention. Naturally, your comments and suggestions are most welcome and will, as appropriate, be incorporated into future columns. In this first installment, I would like to introduce the A.S.P. to those of you who may not be familiar with its current work.

DON'T TAKE THE P IN A.S.P. TOO LITERALLY

The first question to get out of the way is why the activities of the A.S.P. should be of interest to those not living on the West Coast. Certainly, our educational materials can be used as well in New Jersey as in California. But I should also clarify that, despite its name, the A.S.P. is now a national and international organization: today our 7000 members live in every state and 66 other countries. In a very real sense, our name is just a reminder of our origins on the Pacific Coast of the U.S. in 1889 and not an indication of our present scope.

The Society's early history is also important to understanding its present goals and programs. The A.S.P. was born from the fruitful collaboration between professional astronomers at the one-year-old Lick Observatory and a group of amateur astronomers in Northern California. The occasion was a total eclipse of the sun, visible from just north of San Francisco, on New Year's Day, 1889. When the demands of scientific observation, public interest, and media attention completely overwhelmed the tiny observatory staff, Lick's first director, Edward S. Holden, turned to the amateurs for help. So successful was the joint venture, that Holden conceived of the idea of an ongoing organization that would foster exchanges among professionals and amateurs and serve as a bridge between astronomers and the public.

From those local beginnings, the A.S.P. has grown into one of the largest and most active astronomical groups in the world. It is also one of the very few who continue to invite and encourage members from all segments of the astronomical community: professionals, teachers, planetarium educators, students, amateurs, and interested laypeople.

While the Society has a number of professional activities (a technical journal, research awards, and scientific meetings), it devotes the bulk of its attention (as I.P.S. members do) to public education and the improvement of the public understanding of astronomy.

EDUCATIONAL ACTIVITIES

It would be "preaching to the converted" to do any more than remind the readers of this magazine that perhaps the most important task before us in astronomy education today is to help many teachers in grades K–12 overcome their lack of knowledge, experience, and training in conveying the excitement of modern astronomy to their students. I am sure many of you have had the same experience I have had, when a school teacher will confide to you, often in a conspiratorial whisper, that his or her students are very interested in astronomy and space, but the subject is rarely covered in class because the teacher is afraid to appear ignorant.

For the last decade, the A.S.P. has been sponsoring weekend credit workshops around the country for teachers in grades 3–12, focusing on activities and resources for teaching astronomy. Several thousand teachers have already; taken these workshops, either from the A.S.P. directly, or from participants who returned to their communities and offered similar workshops of their own. The next workshop is scheduled for July 11 and 12, 1987, during our 99th Annual Meeting, to be held at Pomona College in Southern California. (A number of I.P.S. members, by the way, have participated in or taught parts of these workshops.)

In late 1984, requests from the workshops participants led us to a new project: a quarterly newsletter for astronomy teachers, combining information on new developments in our field with teaching activities and occasional listings of resources. When we began the project (with the help of a small start-up grant from several Funds interested in science education, and with the cosponsorship of the American Astronomical Society), we expected that news of its existence would spread by word of mouth from our workshop participants to others interested in teaching astronomy. We guessed that eventually a couple of thousand teachers might be interested in receiving such a teaching aid regularly.

We were shocked to receive over 10,000 requests for the newsletter in the first year alone; today, the subscription list is approaching 14,000, larger than the combined membership of A.S.P., A.A.S. and I.P.S. Clearly, there is a need for such a publication out there in the trenches of the nation's school system. (Many I.P.S. members have already asked to be on the subscription list for the newsletter. If your planetarium is concerned with pre-college teaching and would like to receive the newsletter, just send a request on institutional stationery to: Teachers' Newsletter Dept., at the A.S.P. address [given at the end of the article.])

I should mention that we strongly encourage local duplication and distribution of the newsletter. Permission to do this is granted to non-profit organizations in each issue; you don't need to write us, just fire up the photo-copy machine and duplicate to your heart's and budget's content.

SLIDE SETS

Another educational service the A.S.P. has been engaged in, that may be of special interest to planetarians is the production of a variety of slide sets on recent research results in our field. While many excellent slide sets on astronomical topics already exist (from Hansen, Science Graphics, and other sources), what we had heard from many beginning users (even among research astronomers) was that nonspecialists need much more extensive caption materials, especially with the slides depicting non-visible phenomena. Take for example, the new high-resolution images produced with the Very Large Array radio facility in New Mexico. Many of these contain a wealth of information that is not readily apparent, but is relatively easy to convey in a few paragraphs.

Thus, we have been producing a number of new sets accompanied by longer booklets of explanation, designed to acquaint educators and lecturers with some of the best new images in astronomy. Among those we have available now are:

1. *An IRAS Gallery* (25 IRAS images, with a 16-page booklet by Dr. Charles Beichman of Caltech)
2. *The Radio Universe* (40 V.L.A. images, with a 24-page booklet by Dr. Gerritt Verschuur of N.R.A.O.)
3. *Halley's Comet Revealed* (17 slides, including close-up spacecraft views and terrestrial telescope images, with a booklet of detailed captions and mission results by Dr. John Brandt of NASA Goddard)
4. *Voyager at Uranus* (15 Voyager 2 images with a 20-page booklet)
5. *Telescopes of the World* (50 photos of the most important optical and non-optical telescopes around the world, with a large-size 32-page booklet of captions, tables, and background information)
6. *Astronomers of the Past* (50 photos of noted astronomers from Copernicus to Rudolph Minkowski, with a 24-page booklet of capsule biographies written by the A.S.P. History Committee)
7. *Science from the Space Shuttle* (30 images, with a 12-page booklet by astronomer and payload specialist Dr. Michael Lampton)
8. *Worlds in Comparison* (15 "visual analogies," comparing the sizes of objects in the solar system using space-probe images, prepared by NASA's Stephen Meszaros)

If you do not have a catalog of the educational materials the A.S.P. makes available, you can obtain a free copy by writing to: Catalog Requests Dept., A.S.P. at the address below.

COMPUTER SOFTWARE FOR ASTRONOMY

Your new editor and I have recently prepared an annotated listing of 89 pieces of commercially available astronomy software, which appeared in the Sept./Oct., 1986, issue of *Mercury* magazine. The list also includes selected books and articles on astronomical computing, the names and addresses of all the software manufacturers, and references to reviews of many of the programs listed.

Reprints of the 8-page article are available from the A.S.P. for a $ 2.00 donation, which includes postage and handling. Send to: A.S.P., Software List Dept. at the address below.

THE ADDRESS BELOW

Please don't hesitate to write to us if you would like more information on any of the A.S.P. activities (or have suggestions for this column). The reason we suggest you always use a department or person's name when sending us a letter, is that we receive more than a hundred letters addressed to the A.S.P. every day (several hundred on some days) and it really helps us respond faster if we can route your letter to the right staff member or volunteer.

Address all correspondence to:

A.S.P.
1290 24th Avenue
San Francisco, California 94122

Outside the U.S., we must ask for payments to be remitted in U.S. funds. ❑

Regional Roundup

Steven Mitch
c/o IPS Regional Roundup
Benedum Natural Science Theater
Oglebay Park
Wheeling, West Virginia 26003

I will be the editor of "Regional Roundup" beginning with this issue of *The Planetarian*. I'd like to ask regional newsletter editors to please place me on your current mailing list so that I may receive copies of your newsletter. Also, if you would, please send all new information about your region to me for inclusion into "Regional Roundup."

Your cooperation is both needed and appreciated! Thank you!

ASSOCIATION OF MEXICAN PLANETARIUMS (AMPAC)

No report.

BRITISH ASSOCIATION OF PLANETARIUMS (BAP)

No report.

EUROPEAN/MEDITERRANEAN PLANETARIUM ASSOCIATION (EMPA)

No report.

GREAT LAKES PLANETARIUM ASSOCIATION (GLPA)

The annual GLPA conference was held in Cleveland, Ohio, during October 22–26 and was hosted by the Cleveland Regional Association of Planetariums and the NASA Lewis Research Center.

Five Cleveland area planetariums were showcased during the conference. They were: Euclid High School Planetarium, Dan Francetic; Mentor High School Planetarium, Rod Thompson (conference co-chairman); Strongville High School Planetarium, Jon Marshall (conference co-chairman); Cleveland Museum of Natural History, Joe DeRocher; and Midpark High School Planetarium, Bud Linderman.

Friday, October 24th, was spent at the NASA Lewis Research Center and was hosted by Dr. Lynn Bondurant, Jr. Talks included Ronald J. Schertler on the Advanced Communications Satellite (ACTS); Dr. Fred J. Kohl on Microgravity Research; Gary Horsham on Space Station and Dr. Bondurant on New Educational Services. Tours of the Zero-Gravity Facility and the Propulsion Systems Laboratory were given in the afternoon. Dr. Alan Friedman, IPS Past-President, gave an excellent luncheon address entitled "Einstein, Relativity and the Bomb."

The 1987 GLPA conference will be held at the Merrillville Community College Planetarium, Merrillville, Indiana, October 28–31.

GREAT PLAINS PLANETARIUM ASSOCIATION (GPPA)

The 1987 GPPA conference will be held at the Wichita Omnisphere and Science Center in Wichita, Kansas, during the 8th, 9th, and 10th of October. For further information contact:

Jose Oliverez, Director
220 South Main Street
Wichita, Kansas 67202

The Wichita Omnisphere and Science Center recently celebrated their 10th anniversary.

MIDDLE ATLANTIC PLANETARIUM ASSOCIATION (MAPS)

The 1987 MAPS conference will be held April 23–25 at the Vanderbilt Planetarium, Centerpoint, Long Island, New York with Mark Levine as host. This marks the second time that the Vanderbilt Planetarium has hosted a MAPS conference as they also hosted the 1977 conference.

Mark and his staff will be "showing off" a completely renovated, state-of-the-art facility which will be completed in February of 1987. About the only thing that survived the massive change was the Viewlex Special Planetarium instrument. Featured will be a new, home-made automation system, a new panorama system, new sound system, new exhibit gallery, an enlarged cove area and seating.

The Margarette Noble Address will be given by Dr. Tobias Owen. A planetarium concert entitled "Spaces" will be on the agenda as well as observatory sessions utilizing the 16" Cassegrain and the 4 ½" refractor.

Roxanne Peery is the new editor of the MAPS news letter "The Constellation."

Mark Peterson of Loch Ness Productions and John Serrie of Future Music are teaming up once again for a concert at the Hayden Planetarium in New York City in May.

New board members recently elected to MAPS are Lee Ann Hennig, Alexandria, Virginia and Steven Mitch, Wheeling, West Virginia.

NORDIC PLANETARIUM NETWORK (NPN)

In case you haven't yet heard the news, the 1990 International Planetarium Society conference will be held at the Dalarnas Museum Kosmorama Space Theater in Falun, Sweden. Lars Broman will be the conference host. More about the 1990 conference will appear in the President's message column.

PACIFIC PLANETARIUM ASSOCIATION (PPA)

No report.

PLANETARIUM ASSOCIATION OF CANADA (PAC)

No report.

ROCKY MOUNTAIN PLANETARIUM ASSOCIATION (RMPA)

The next RMPA conference is scheduled to be a joint meeting with the Pacific Planetarium Association (PPA), October 8–10, 1987, at the Fleischmann Planetarium in Reno, Nevada, with Art Johnson as host.

Arthur Barton is now the assistant director of the International Space Hall of Fame in Alamogordo, New Mexico.

Rod Binder has returned to the Casper, Wyoming, Planetarium after a 15 year hiatus. Rod was one of the first RMPA presidents.

Mark and Carolyn Collins Peterson have created a new 10-minute show the Brevard Community College Planetarium in Cocoa, Florida. They have also been busy doing a series of new programs for the McDonnell Star Theater in St. Louis. Carolyn has been elected as president of RMPA and is also the RMPA newsletter editor.

Katherine Becker was elected RMPA secretary/treasurer.

The Gates Planetarium is beginning an ambitious educational program and is running 3 programs geared to school groups. Director Bob Wallace says that they are averaging 1000 students per week.

SOUTHEAST PLANETARIUM ASSOCIATION (SEPA)

Tentative dates for the 1987 SEPA conference are June 7–13 at the Brevard Community College Planetarium, hosted by Mike Hutton.

Jon Bell of the Peninsula Nature and Science Center in Newport News, Virginia, assumed the role of president of SEPA beginning January 1, 1987.

Dave Hostetter of the Lafayette Natural History Museum is the new president elect of SEPA. Sue Griswold of the Charlotte Nature Museum has been elected secretary/treasurer.

SOUTHWEST ASSOCIATION OF PLANETARIUMS (SWAP)

Jim Rusk reports that the next SWAP meeting will take place at the University of Arkansas—Little Rock Planetarium on April 23–25, 1987. For details, contact Keith Johnson at:

UALR Planetarium
33rd and University
Little Rock, Arkansas 72204

Many SWAP members have been helping students with the astronomy part of the Academic Decathalon. Donna Pierce, Highland Park ISD Planetarium, made a videotape in the planetarium that covers most of the astronomy topics on the test. She made the video tape available for free copying by local districts that do not have planetariums. Eloise Koonce, Richardson ISD Planetarium, began preparing students for the Decathalon last summer in the planetarium. ❑

Focus on Education

Mark S. Sonntag
Planetarium
Angelo State University
Physics Department
San Angelo, Texas 76909

EDITOR'S NOTE: We are all familiar with the star shows distributed by the Hansen Planetarium. Many planetarians (worldwide) have benefited from these programs. However, you may not be aware of the great educational impact the Hansen Planetarium has had on its home city and state. Its programs may reach a higher percentage of students in the region it serves (the entire state of Utah) than any other planetarium. Its combined "in-house" and "outreach" programs are given to over 120,000 students annually. —MS

HANSEN PLANETARIUM OUTREACH PROGRAM

Ruth G. Lynch
Science Education Specialist
Hansen Planetarium
15 South State Street
Salt Lake City, Utah 84111

The Hansen Planetarium outreach program is designed to teach space science to school children who live too far away to come to the planetarium in Salt Lake City. We also want to stimulate interest in the students to come to the planetarium with their families when they visit Salt Lake City.

The program got started at a time when the planetarium requested funding from the Utah State Legislature for school star shows. Legislators from rural Utah weren't happy about contributing tax money for this purpose because their school districts were too far away to visit the planetarium. They would be happier if the planetarium had a program from which their school children would benefit. At the same time, staff members from the planetarium were notified that NASA had a van full of space science equipment from their Space Mobile Program to donate to a museum. The Hansen Planetarium wrote and requested the donation for developing an outreach program. NASA decided to donate the equipment and provide training to the Hansen Planetarium.

Planetarium staff then went before the Legislature and asked for funding for this program. This proposal failed in Committee Meetings but was later approved after planetarium staff did some lobbying. The amount allocated for an outreach program was small at first. The planetarium received $30,000, which was sufficient for one person to go out on the road. A van was purchased from Hertz-Rent-a-Car and painted with the title *Astrovan*. The number of students contacted during the first year was 30,000.

The program has grown from this humble beginning to include 2 full-time lecturers and a part-time lecturer to go out on the road. We purchased a new van in 1985 and christened it the *Star Cruiser*. Last year we received $60,000 and contacted 58,697 students.

The program we present consists of an assembly for the entire student body in the school followed with classroom visits. The topic of the assembly has been rockets and living in space. The students are shown how a rocket works in a very dramatic fashion. They watch a home-made hydrogen-oxygen rocket operate, and we tie this in with the operation of the space shuttle. We then surprise students by firing a solid fuel rocket engine that is attached to a rotating arm. Liquid nitrogen demonstrations help the students understand how cold the rocket fuel really is and how cold temperatures can affect rocket equipment. The classroom discussions that follow vary according to the age of the students. Elementary schools frequently request our portable planetarium presentations. The portable planetarium is inflated with a fan and can be set up in a multi-purpose room. A class of students can then crawl inside and get a star identification on the current night sky.

Secondary schools frequently request laser disc presentations on astronomical topics. We can also give a variety of slide presentations or we show movies on astronomical topics during the classroom discussions.

Next year, we are going to use robotics during our assembly program. We will demonstrate how robots help us in space exploration and astronomy research. We have a Gemini robot that self-navigates in a room using sonar. We want to compare this robot with a future Martian explorer. This robot can also detect motion, detect light, recognize voices, give weather reports, and many other things. We have a Scorbot robotic arm

(Concluded on page 7)

Jane's Corner

Jane G. Hastings
Thomas Jefferson Planetarium
4100 West Grace Street
Richmond, Virginia 23230

I admit it. I have been hansenizing. But I'm not sorry. My hertzspring had dried up and the Saganites kept on coming to the shows, demanding dipperhea and expecting constellelation. And me with no Expounding Universe created by gerberization to quell the seemingly insatiable perihellions. After all, I have lot of those Utah shows. So why not?

Hey! It works. He said this was the way to get it going, to use them in everyday conversations. He: Jon Bell, of Virginia Living Museum Planetarium, Newport News, Virginia. He invented the "sniglets" above. "A sniglet", says Jon, "according to [Rich] Hall [on HBO's TV feature "Not Necessarily the News"], is any word that should be in the dictionary but isn't."

Perhaps we should add, "at least not yet." Jon contends that "there is a desperate need for the coining of new words and phrases for planetarium phenomena that currently have no names." Here are some of Jon's sniglets:

The burnt-out slide projector that blows at the beginning of a show is called an Ektalump.

When a group of school kids spends the first 20 minutes of a show "finding" the Big Dipper in just about every part of the sky, this affliction is know as Dipperhea.

Constellelation is the emotion felt by an audience member when he finally recognizes one of the many obtuse star patterns pointed out by the lecturer.

When you take several shows that you've gotten from Salt Lake City and combine them to make a whole "new" show, then you are using a technique called Hansenizing.

The technique of building great special effects out of Coke bottles, tin foil or baby food jars is called Gerberization.

Astrologic is the long, involved explanation you give people about the fallacies of astrology - which has no real effect on their opinions.

Any skeptical reader of *Worlds in Collision* is known as a Veliskoffsky.

The Hertspring is the academic source of those complicated, unintelligible diagrams that keep cropping up in planetarium shows.

Any obnoxious kid who gets too close to you during a show is a Perihellion.

A Saganite is a member of the audience who knows more (or professes to know more) about astronomy than you do.

The sharp crackling sound that the projector emits when the star lamp is turned on is called a Spitzel.

An Expounding Universe is a self-explanatory cosmos.

The person who assists the laserist during a light show, providing special planetarium effects is known as an Incandescentist.

The Buster Crabbe Nebula is the ultimate destination point of radio and TV transmission of all those old Flash Gordon serials.

Any attempt to discredit the space-time theory is an Einstain.

And finally, although they are called the 'Seven Sisters', we can only see 5 or 6 stars plainly". According to Jon, I have just indulged in Byades, concluding remarks about open star clusters.

I certainly see no reason to continue this ...do you? Don't tell me you know some more, some he's missed...

Overheard at SEPA 1986, Morehead Planetarium in Chapel Hill, North Carolina:

- from Mike Hutton, praising automated planetariums (like his at Brevard Community College in Cocoa, Florida): "Well, first you rewind the tape, then you look and see if the audience is seated, push the button, and open the refrigerator in back for a cold drink."

- Jim Manning of the Morehead staff: "Here in town you will see a certificate with an "A","B", or "C" displayed in the window of restaurants on your list. If the place has a "C" rating, look at their hands; if it has a "B" rating, it's probably OK; and if it has an "A", don't believe it: don't go in!"

- in a planetarium by Doris Metts, banquet speaker and member of English faculty at UNC Chapel Hill: Narrator: "It takes the light of that star four hours to reach the earth".Small voice from the darkness: "Oh, Mommy, can we stay that long?"

- Winner, Best T-Shirt Contest: Tom Hocking, Ramseur, North Carolina (Space News Publishing Co.): " If the right side of the brain controls the left side of the body...then only left-handed people are in their right minds".

- Best Button: Kris McCall of Brest Planetarium in Jacksonville, Florida: "Walk softly...you're in another man's sky." ❑