NUNDEHUI PLANETARIUM, OAXACA, MEXICO

‘Land of the Skies’
Advantages of membership in the International Society of Planetarium Educators can be freely obtained by writing to:

Mr. Walter Tenschert
Thomas Jefferson High School
6560 Braddock Road
Alexandria, VA 22312
THE PLANETARIAN is published each March, June, September, and December by the International Society of Planetarium Educators, Inc., under the auspices of the Publications Committee.

To make a change of address, please send an old mailing label, along with the new address, to:

Ronald N. Hartman
Mt. San Antonio College
Planetarium
Walnut
California 91789

Please allow 30 days for an address change to take effect.

EDITOR: William Fagan
Circulation Director: Ron Hartman
ISPE Publications Chairman: John Cotton

* * * * * * * * *

CONTENTS

Planetarium's On Parade.............. 5
Direct Image Transfer................ 7
William H. Lowry
Contact Kodalith Slide Masking...... 12
Dwight Gruber (PAC Newsletter)
Soviet Space Exhibit in Canada...... 16
David F. Hurd
Where Are Our Spaceships?........... 17
NASA Activities
Survey to Evaluate the Calgary
Centennial Planetarium.............. 19
Sig Wieser
Involving Schools in Astronomy..... 21
H.D. Teuscher (MAPS Newsletter)
To Any Critics Who Are Listing..... 24
David A. Rodger (PAC Newsletter)

Features

Editor's Notes....................... 2
I.S.P.E. Conference.................. 3
How To Make It -
An Adjustable Projector Stand 26
E.Q. Carr
A Rotating Planet Projector.... 27
David F. Hurd
The Starbow Projector......... 31
E.Q. Carr
Moon Images....................... 32
E.Q. Carr

* * * * * * * * *
EDITOR'S NOTES

With the experience of one completed issue now behind me, I give you my second attempt at the job of editing.

The most obvious difference you will note is the greater number of articles, all shorter than the ones in the previous issue. This change was necessitated by a lack of long articles and an abundance of shorter ones, lifted from a couple of the regional newsletters.

I would appreciate your response to the HOW TO MAKE IT section. With sufficient contributions from the membership, this could easily become a regular feature, if you find it worthwhile and helpful. It would require a lot of contributions from a good number of gadget-makers, but for those of us who lack that inventive insight, it could be a valuable service. Let me have your thoughts on this suggestion.

You need to know that at this time I do not have available enough material to put together for the next issue. I NEED contributions from anyone on any topic. Please do not send anything that has previously been published elsewhere, unless you can provide written permission for it to be reprinted in our journal. If a drawing or photograph is to accompany an article, it MUST be high contrast black-and-white...no Xerox or Thermo-fax copies. These problems have plagued us before.

By now, hopefully, you have made your arrangements for the meeting in Boulder. Just in case, for some reason you did not receive the registration information, it is included in the I.S.P.E. Convention feature of this issue.

I do not intend to repeat old apologies for the style, the looks, or the contents of this journal. This might not be exactly what we want, maybe someday it will be much better. We have a journal! It is being published quarterly! If the quality and looks improve, it will be from your efforts. Contribute your work and watch your journal grow!!!

See you in Boulder.

Bill Fagan
Oakton High School Planetarium
2900 Sutton Road
Vienna, Virginia 22180
I.S.P.E. CONVENTION - '76

You are cordially invited to attend the 1976 ISPE Biennial Meeting scheduled for August 9 to 12 on the Boulder campus of the University of Colorado. Activities will revolve around the beautiful new Fiske Planetarium which opened last fall.

Activities

The meeting will begin on Monday morning, August 9 and conclude Thursday, August 12. A detailed schedule of events will be mailed with acknowledgements to those who pre-register prior to July 9, 1976.

Fee

The registration fee will be $40. This includes instructional materials, refreshment breaks and local tours of planetarium facilities. Please make your check payable to the University of Colorado.Registrations and fee should be received no later than July 9, 1976.

Housing

Housing is available in the Kittredge Residence Halls on campus. The rates including tax for room and board are: single $67.79; double $54.20 per person.

Rates include lodging Sunday through Wednesday and eleven meals, beginning with breakfast on Monday and ending with lunch on Thursday. Also included is the cost of a mountain cookout. Housing payment is due upon arrival and should not be in advance. Credit cards cannot be accepted by residence halls.

If you would prefer to stay at a local motel, please check the appropriate box on the registration form. You will be sent a list of local motels. Persons not staying at Kittredge may purchase individual meal tickets at Kittredge on a first-come basis. Tickets for the cookout must be purchased one day in advance.

Transportation and Parking

Transportation from Denver's Stapleton International Airport is available by Denver-Boulder RTD bus. Persons staying at Kittredge will be issued parking permits for the Kittredge lots during registration. Those not staying at Kittredge should park in Lot "S." Permits will be issued during registration.

Recreation

Guest privileges are available to participants at the CU Recreation Center. The facilities include handball and squash courts, swimming and diving pools, suanas, tennis, an indoor ice rink and fully equipped gyms and exercise rooms. Additional information about the facilities will be available at registration.

Exhibits

The conference will feature extensive exhibits located adjacent to the main meeting room.
REGISTRATION FORM

International Society of Planetarium Educators
1976 Biennial Meeting
August 9 to 12, 1976
University of Colorado, Boulder

Name__________________________________________________________

Planetarium__________________________________________________

Address_______________________________________________________

City__________________________State________Zip_________

My spouse will___will not___accompany me.

My spouse does___does not___desire planned activities.

Campus Housing Reservation: ______Single ______Double

Name of Roommate_____________________________________________

____My children will accompany me.

Please indicate names, ages and sex of children and whether doubles or
doubles will be required_______________________________________

____Send me information about Boulder hotels and motels.

DO NOT SEND CAMPUS HOUSING PAYMENT IN ADVANCE.

PAPERS

I will___will not___present a paper.

Title:

Category:

(EXAMPLES: planetarium curricula in the schools, resource materials,
hardware, public planetariums, interactive teaching aides, etc. This
information will help us in program planning.)

Abstract:

Please complete and return this form together with your check for $40 made payable
to the University of Colorado by July 9, 1976 to: Bureau of Conferences and Institutes,
Academy 217, 970 Aurora Ave., University of Colorado, Boulder, CO 80309.
On July 17, 1976, the city and state of Oaxaca, Mexico, will dedicate a new Planetarium built and equipped jointly by the people of Oaxaca and of Palo Alto, California.

It is located on the Hill of El Fortín, high above the beautiful city of Oaxaca and visible from the city's Zocalo (Park). Nearby is the Astronomical Observatory, dedicated on February 10, 1973, in another joint program.

"Nundehui" is the name that has been chosen for the Planetarium itself and is a Zapotec word for "Tierra del Cielo," or when translated into English, "Land of the Sky." The "Land" of this sky is located 17° South Latitude.

This Planetarium Project was initiated in September of 1974. Project Director is Marvin J. Vann, Director of the Foothill College Observatory and Planetarium at Foothill College, Los Altos Hills, California. Funding was a joint effort between the two cities; supported in Palo Alto by "Neighbors Abroad" - an affiliate of the United States' Sister City Program - and in Oaxaca, by Manual Zarate Aquino, Governor.

The Planetarium instrument, a Goto Jupiter, was obtained by "Neighbors Abroad" from the Olivet Nazarene College, Kankakee, Illinois, at a very minimal cost, making the college a really prime contributor to the project. Other donations of time, assistance and monies came from Trans-World Airlines, Inc., Mexicana Airways, the Syntex Corporation, ITEC and the Viking Freight Transportation Co. A bronze plaque inscribed with the names of these donors and all others who made a sizeable contribution, will be installed at the Planetarium.

Edith Jacobsen of Moss Beach, California, was chosen to do the preliminary designing; Rafael Ballesteros Vizcarra of Oaxaca, was put in charge of the final designing and actual building of the structure. The Planetarium building features an abundance of locally made brick and a green stone that is native to the area.

The Nundehui Planetarium Description

The Planetarium Foyer and Chamber are fully carpeted, as are the walls and seat bases. The purpose of the foyer is to introduce the visitor to astronomical vistas. Appropriate background music will fill the air. Ten Serigraphs of the moon adorn the foyer, which were made by Len Gittleman, donated by the ITEC Corporation and suitably framed by the Syntex Corporation. Large scale photographs of astronomical objects that can be seen in the adjacent observatory will also be displayed, along with large up-to-date ecological space shots of the earth and other exhibits appropriate and pertinent to the Planetarium program. The general motif and decor of the foyer are intended to portray local cultures, this being accomplished by extensive use of colorful murals. Overhead and spotlighted will be signs of the zodiac in bas-relief.

The Chamber boasts seats which were especially designed and constructed in Oaxaca and are a unique innovation to planetariums. The circular chamber will be
large enough to support a 40-foot dome and contain more than 125 seats.

At the top of the wall where the dome begins, a cove will project into the chamber about two feet to form a platform upon which various projectors will be placed. The cove will contain electrical conduits for the special effects projectors and will be a base for the installation of various skylines as desired. Twelve Ektographic Carousel Projectors will afford the Planetarium a panoramic spectra.

The hemispherical dome, 40 feet in diameter and consisting of white acoustical plaster, will be supported by the walls and of course is the surface upon which the star images are projected by the aforementioned Goto Jupiter instrument.

**Planetarium Objectives**

Serious students of science will be able to use the Planetarium and its programs as rich supplemental aids to accompany the regular science classes of the technical school in Oaxaca. Mutual exchange of students of science between the facilities of Palo Alto and Oaxaca is a distinct possibility.

As other cities and institutions in Mexico make plans for installations of observatories and planetariums, the unique facility at Oaxaca will provide a focal point for training people who will be responsible for the operation and servicing of equipment. Citizens of Oaxaca will be able to train for these jobs as they become available.

Planetarium programs will be developed that are of both general and local interest. As part of the Oaxaca Science Center, the Oaxaca Planetarium will become a leader in program development. It will be an inspiration to other cities and states in Mexico by providing unique program material. It will contain the necessary instrumentation and devices to produce these special programs. In addition, it can become a center for the exchange of programs with other planetariums in the United States where there is a growing interest in and need for programs in the Spanish language. An additional benefit of the Center for Program Development will be its ability to develop Mexican programs that are specific to the area.

Undoubtedly there are many other objectives that will come to light as the project progresses which will lead to participation by the citizens of Oaxaca. Programs arising from these objectives will help to realize the great potential for enjoyment and understanding between the people of the two cities.

**Planetarium Dedication**

The dedication ceremony on July 17 will have some 40 Palo Altans in attendance and is only a part of the festivities that have been planned. Mr. Vann will give the initial program and talk titled, "Oaxaca - Land of Enchantment," which will be translated for the people of Oaxaca by Dr. Renato Zarate. Included is a demonstration of the equipment, sound system (with appropriate regional music), and panoramas of the "Land of Enchantment" (using the Planetarium projection system).

An interesting program for members of the I.S.P.E., complete with slides, will be given by Marvin Vann at the Boulder Convention in August.
DIRECT IMAGE TRANSFER

by William H. Lowry

Often it is desirable to produce an image on a slide which is of a specific size and shape. Example: making cove mounted/projected constellation outlines, "Blackgrounding" color slides (a process which falls into the general category of contour fitting of two slides), etc. The idea behind "direct image transfer" is simply this, the projector is used as a camera, the camera as a projector. (See Figures 1 and 1a)
Any Projector with its Objective Lens removed

Rolled Cardboard

Camera

Folded Cardboard or Wood Block to support Roll

Book or Wood Block to make Camera the same height as the Projector Light

Tape or Chalk Marks will keep the Camera in place

Figure 1a

(Another arrangement for the columnated light source and the 35 mm camera is given above.)

1. A camera having an openable back is placed on a copy stand or tripod facing down onto a flat work area (a table or the like). As a camera I use a 35 mm SLR, (55 mm lens f 1.8).

2. A roughly columnated light source (as that in a single slide projector without the objective lens) is mounted two to three feet above the camera, and the light directed toward the camera back with a cardboard tube discarded from a used up roll of aluminum foil, wax paper, etc.

3. The system thusly constructed is like a projector where the camera lens has taken the place of the projector objective lens.

But there is a built in advantage.

4. If a. A slide is now placed in the focal plane of the camera;
   b. The camera iris is opened to its greatest diameter; and
   c. The shutter is held open, either on "T" setting or by a cable release; there will appear a partial image \( I_0 \) of the original slide on the work area.

5. Let us assume we can now capture a copy of that image on a piece of paper, call the captured copy \( I_r \); this can be done manually or photographically.

6. Now, to produce a slide of the image \( I_r \) which will be effectively identical in size and shape to the original slide, it is merely necessary to do the
following:
   a. Turn off the light source.
   b. Remove the original slide, and set it aside.
   c. Stop down the camera.
   d. Release the shutter.
   e. Cock the shutter.
   f. Place film in the camera and seal it.
   g. Turn on copy floods.
   h. Photography the image on the paper (I_r).
   i. And process the film.

7. The resulting "slide" will contain an image effectively identical to the original in size and shape.

Note: The most critical restrictions during the entire procedure are as follows:
   a. Do not change the height or angle of the camera with respect to the work area throughout the production of a given slide.
   b. Do not change focus throughout the production of a given slide.
      (Although the image may vary slightly because of focusing, this problem can be gotten 'round by focusing the camera on some reference image in the plane of the work table before the process begins, then not changing the focus throughout).

EXAMPLE:

Contour masking of slides

Suppose we want to isolate a part of a slide for projection, generally termed "blackgrounding."

Assume we are working with the following:
   a. A standard 35 mm slide original with an object of reasonably distinct outline somewhere in the field.
   b. A 35 mm SLR camera, "normal" lens, 50 mm or so.

1. The slide film original is carefully removed from its mounting, and
2. Placed in the focal plane of the SLR (back open in the copy position).
3. A piece of clean glass or small pieces of masking tape can be used to hold the original flat in the focal plane, so that shape and focus are true. I usually put it in emulsion side down.
4. The columnated light source is turned on and directed as much at right angles
as possible to the focal plane, through the original slide.

5. Be sure the camera iris is at the lowest numbered f-stop possible, and that the shutter is open.

6. A part of the image of the slide is now being projected onto your work area.

7. The idea now is to trace the outline of the image you want to contour mask. So adjust the height of your camera (and if necessary, the source) to give you the desired traceable detail in the slide. This depends on how good a tracer you are — I like 'em big.

8. Once you've determined a rough height, release the shutter, turn a copy light on momentarily, focus on an "x" or a pencil, or whatever in the plane of the work area. Then off with the copy lights, open the shutter and lock it open.

9. Now, trace the outline of your desired image (I use a pencil).

10. Room lights on.

11. Now black in the areas you want visible with India ink, flat black paint, black felt tip, etc.

CRITICAL: Leave your camera in position and turn off the columnated source.

12. Remove the original from the camera focal plane carefully so as not to disturb the camera.

13. Release the shutter.

14. Stop the lens down.

15. Cock the shutter.

16. Off with the room lights, on with the red safe light.

17. The camera can now be loaded with Kodalith or the like (careful don't move the camera).

I usually cut a single frame or so of film and tape it into the focal plane, since I do one complete contour mask, from beginning to end, at a time.

18. Center the hand drawn black image under the camera (the camera should already be in focus).

19. Floods on, photograph it.

20. Process the negative, dry it thoroughly.

Your result will be a clear space the same size and shape as your original image, on a black background.

Trim the mask, tape it securely to the original slide, matching the shapes by eye. There you have it.

NOTE: If the desired image covers a large portion of the original slide, and cannot be projected completely, just trace a little, then move the original
around in the focal plane, trace some more, etc., until your drawing is complete. Here it is very important to keep the original flat in the focal plane. I recommend starting out with a clear cut image like a cartoon that only fills about one third or so of the frame.

The method can be used for all sorts of things:
1. You can make overlays in outline to show, let's say the "hare" in the moon. Here one single slide projector would hold the moon slide, and another would hold your overlay in high contrast.
2. By using this copy method and one other technique, you can make your own rather precise constellation outlines on the dome.

Many of our patrons like to see those neat outlines of the constellations on the sky. Since we're limited to the number of circuits, balance, etc., in our planetarium instrument, our most practical method of projecting these images is to set the planetarium for a specific heading, epoch, date, time of day, latitude, and then to project images from the cove. Here we'll use the projector lens as a part of the camera.
1. Remove the projection lens from one of your single slide projectors, specifically the type or focal length of those you will be using to project the outlines.
2. Remove your normal SLR lens, set it aside.
3. ...Projector lens in one hand, camera body in the other. Now here's your first problem, you have to be able to use that projector lens as the camera lens.
4. My SLR is a Pentax type lens mount. It turns out that I can just fit a toilet paper tube into the front of my camera body. Then by wrapping the projector lens with thin cardboard, I can slip the lens into the toilet paper tube (giving me focus capability). Your arrangement may have to be different.
5. Load the camera with film. High speed negative film is good, but Kodalith will do.
6. Now carry your "camera" into the planetarium theater, turn on the stars, set the instrument for just the way you want it at the time you introduce the projection.
7. Place your camera as close to the position intended for the projector as possible. I shoot from the cove, so I set up right underneath my projector spot.
8. Dark adapt yourself.
9. Focus on the area of the sky you want to reproduce (whether or not you get the whole constellation will depend on the focal length of the lens).

10. Take a time exposure depending on the film. (For a 30' dome, Tri X needs 2 1/2 min.; Kodalith needs 25 min.; both at f 4.5.)


12. You now have an image of your planetarium stars.

13. You can make stick figures or full bodied ones, circle special stars, whatever, by simply taking your star image slide and projecting it onto the work area just as was done before in contour masking. Following that same procedure will produce a slide, color, black and white, high contrast negative, the size and shape of the dome stars when projected.

One word of caution: When working with extreme angles on the dome you may note distortion when using full bodied figures and the like, but, even so, the image should "fit" the stars. Also remember, at such angles you will experience focus difficulties when projecting, these are normal.

CONTACT KODALITH SLIDE MASKING

by Dwight Gruber (P.A.C. Newsletter)

This contact printing method of masking slides works for most applications. It is most successful on slides of coloured objects on a black background or blue or green ones on a red background. Moderate success can be had with dark subjects on a light background, red objects on blue, or light on light, as long as there is a heavy black outline. The degree of success on other kinds of slides depends on the ability, imagination and patience of whoever is doing the work. The one kind of slide I have had little success with is that of a deep sky kind of object; star clusters and galaxies work marginally while nebulosities are unsatisfactory. I am still working on these, so if anyone comes up with solutions, let me know.

The key to this masking method is in Kodalith Pan film which is sensitive to the entire visible spectrum. Kodalith Ortho is only sensitive to blue and green. Kodalith Pan does have one drawback - it must be handled in total darkness. Otherwise, it is handled and processed just like ordinary Kodalith sheet films. Follow the instructions received with the film.

You will need the following materials:
1. Dismount your slides and separate them by densities. Lighter slides will need less first exposure than darker ones. You will save time and materials by contact printing comparable slides together.

2. Put your slides in the contact frame, turn out the lights, and put the Kodalith Pan film in contact with them, emulsion to emulsion. If you do not have a contact printing frame, a sheet of glass on the enlarger baseboard will do. The kind of proofing frame which holds negatives in rails is unsatisfactory, as it will not allow tight contact between slides and film. Some practice will be necessary to put film, slides and contact frame together in the dark, as everything has a maddening tendency to move around.

3. Place your contact frame under the enlarger and make the first, or internegative, exposure.

Exposure is best determined by trial and error. I expose for about twelve seconds at f/5.6 under a Beseler MCRX enlarger, but different enlargers, lenses, lamps enlarger heights and slide densities will demand differences in exposure. If you already have experience with Kodalith Ortho, you will find that Kodalith Pan is significantly faster.

For the internegative exposure, the most important consideration is detail. The beauty of contact masking is its ability to retain fine detail in the mask without an extensive secondary art work step. Experience show that the amount of detail retained is controlled for the most part by the internegative exposure. For black and white slides, for slides with little red or yellow colours, or for slides with red background, Kodalith Ortho will work as the internegative film.

4. Process the internegative.

5. Take the dry internegative to the light table and opaque all the clear places in the image area (or background area, if your slide has a light background). A handy tool for spotting masks, as well as for opaquing directly on the slides, is a rapidograph pen. The finer point pens are able to opaque areas a brush
would hopelessly smear. Some experimenting needs to be done here to find an opaque ink that will not shrink up and crack. Regular dilute photographic opaque can be used, but has a tendency to quickly clog up the pen.

6. Take the opaqued internegatives back to the contact frame, contact print them on Kodalith Ortho film and process. The 8 x 10 Kodalith film at this point is a timesaver, as you can get many more frames on one sheet of film.

6a. Masking slides with a light background requires one more contact printing step to give a black background.

Now, at this point you should have a sheet of frame-size masks, with opaque backgrounds and completely clear areas for the image.

7. Opaque any pinholes in the background.

8. Cut the masks apart into their frames and pair them up with their corresponding transparencies.

9. Tape a mask by two diagonal corners to the light table.

10. Relieve the sides (not the sprocket holes) of the slide by cutting away some of the background area on each slide. This is to allow you to tape the slide to the mask.

The amount of background you can cut away and where you can cut it away from, depends on the image. Be sure to leave sufficient film area for the slide to stay in one piece, and try to avoid cutting sprocket holes and film edges.

If there is not sufficient background to cut away, don't. You will be able to work around the problem.

11. Place the slide over its mask and register it.

A more positive way of registration than using the image is by using the film identification and frame numbers along the upper and lower edges of the transparencies or, in extreme cases, by using the sprocket holes. This is why it is important you do not cut them away. When both the identification and frame numbers are aligned, so is the image.

When the slide is finally put on the mask, the two films will not be emulsion to emulsion. But don't let it worry you. The only way to have that situation on the final product is to make the internegative emulsion to base. It is far more important to have the original contact emulsion to emulsion than it is the final result.

12. Tape the slide to the mask by putting tape across the area you relieved. This particular step, along with the instructions revealed in step 10 are shown
If you could not cut the slide, put the tape across the sprocket holes, and make sure it sticks to the mask through the holes. The closer you can get the tape to the image, the more positive the resulting masked image will be. Scotch Magic Mending Tape is by far the best tape for this purpose. It is cheap, easy to handle and doesn't get gooey or dry up with age. In addition, it sticks like crazy. We had one masked slide melt in a projector, but the tape stuck in place on the slide and held the slide and its mask in as good a register as could be expected, from two buckled pieces of film.

13. Remove the masked slide from the light table, trim it, and mount it in a glass slide mount.

Glass mounting is recommended as it is a positive way to keep the slide and mask in tight contact. We use Perro-Color slide mounts, imported by Leitz. They are expensive but they are also durable, positive and extremely quick and easy to put together.

The above system of slide masking has been working well for us for almost four years now. You will probably have to do your own experimenting with the process, but I hope my instructions and hints help.
SOVIET SPACE EXHIBIT IN CANADA

by David F. Hurd, H.R. MacMillan Planetarium
Vancouver, B.C., Canada

Starting in October of 1976, a major Soviet Space Exhibit will begin a lengthy tour of Canada. The exhibit, the largest ever shown in North America, will trace the entire history of Soviet Astronautics. It will include a number of full size models of manned and unmanned spacecraft including Lunakhod and Vostok.

The exhibit was arranged by the H.R. MacMillan Planetarium and the Embassy of
the Union of Soviet Socialists Republics in Ottawa. It is sponsored by the Soviet Academy of Sciences and the various host Planetaria and Museums.

In total, over 86 tons of full size and scale models will be displayed. These range all the way from Sputnik I up to Salyut... and beyond. The displays are supplemented by a number of movies tracing the history of Soviet rocketry back to the time of Tsiolkovsky. One of the highlights of the display is a large working model of the Baikonor Cosmodrome. Each and every hour, a Salyut payload and launch vehicle is wheeled out, erected, counted-down, and launched... all with the appropriate Russian dialogue and translation.

The Soviet Space Exhibit has a total area of over 20,000 square feet. It is staffed by eight technicians and two translators who operate the dynamic models and answer any questions. The display will probably be opened in at least one location by Cosmonauts and officials of the Soviet Academy of Sciences.

The Western Canadian tour of the exhibit is not the first time that the display has been in Canada. During the World's Fair of 1967, a small portion of the exhibit was available at Expo in Montreal. And, in the fall of 1975, the exhibit formed the inaugural presentation of the new Winnipeg Convention Centre. During the twelve days the displays was open in Winnipeg, over 100,000 people visited the Convention Centre. The majority of these visitors were students from schools throughout the Canadian prairies, plus, a very large contingent from Minnesota, Iowa, Wisconsin, the Dakotas and Montana.

WHERE ARE OUR SPACESHIPS?
NASA ACTIVITIES, February, 1976

What goes up must eventually come down. Right?

Wrong! That old saying was permanently laid to rest in 1959 when the Soviet Union's Lunik 1 and America's Pioneer 4 spaceships went up and didn't come back. For that matter, they never will.

But this is only part of the overall story. According to the latest box score, man has flung over 1,700 "stones" into the heavens since the Space Age blossomed nearly two decades ago, and more than 700 of them are still out there.

The U.S. tally, counting launches for other nations and organizations, is 829 ups and 404 downs. leaving a balance of 425 AWOL spacecraft - most of them last seen at KSC launch pads in Florida and California.

This raises an interesting question: Where are our missing spaceships?

The majority are scientific, communications and meteorology satellites whirling around the Earth in orbits ranging from less than 100 miles to thousands of miles. Between 40 and 50 are still functioning and carry familiar names such as Explorer, ATS, Westar, Intelsat, SMS, Nimbus, Landsat and OSO. Like their now-silent cousins, they will someday return to Earth in a fiery death.

Forty-three spaceships have bid an eternal farewell to Earth. They include 25
that now claim the Moon as home; 13 that have become solar-orbiting gypsies; three that have staked out future claims on Mars; one that is heading for a rendezvous with the stars of the galaxy; and one whose future course is yet undecided.

The Moon is by far the largest collector of wayward NASA spaceships. Its surface is littered with the intact or crashed remnants of the following craft:

6 Rangers - launched between April 1962 and April 1965. Rangers 4 and 5 were unsuccessful and missed their target points on the lunar surface. Ranger 6 made its target but failed to transmit any photos before crashing at 6,000 mph. Rangers 7, 8 and 9 returned excellent photos of the surface during their 20- to 25-minute suicide dives.

7 Surveyors - launched between May 1966 and February 1968. Of the seven, all were successful except Surveyor 2, which crashed during its soft-landing attempt and Surveyor 4, which landed safely but failed to transmit data and photographs.

5 Lunar Orbiters - launched between August 1966 and September 1967. All five Orbiters performed excellently and returned thousands of photographs to pave the way for the Apollo lunar landings. After completing their missions, the Lunar Orbiters were deliberately crashed onto the Moon's surface.

7 Lunar Modules - launched during the Apollo Lunar Landing Program. Of eight Lunar Modules carried to the Moon by Apollo spacecraft, only LM-7 (Apollo 13) returned toward Earth. After serving as a "lifeboat" for the crew during the aborted lunar mission, it was discarded and subsequently burned up on reentry into the Earth's atmosphere. The other seven LMs completed their lunar missions and were commanded to crash onto the Moon. Also left behind on the lunar surface was an assortment of Apollo equipment, some still functioning and three Lunar Rovers.

The Sun has staked the next largest claim on NASA spacecraft. Pioneers 4 through 9, launched between March 1959 and December 1968, are in sweeping solar orbits. Amazingly, Pioneers 6 through 9 are still working. In fact, Pioneer 6 celebrated its tenth anniversary on December 16, 1975.

Other solar wanderers include Mariners 2 and 5 (Venus flybys), launched in August 1962 and June 1967; Mariners 4, 6 and 7 (Mars flybys), launched in November 1964, February 1969 and March 1969; Mariner 10 (Mercury/Venus flyby), launched in November 1973; and the German-built Helios 1 Sun probe launched December, 1974.

Mariner 9, launched in May 1971, has been orbiting Mars since 1972. The now-dead spaceship will crash on the Martian surface in about 50 years. Vikings 1 and 2 will land on the surface of Mars next summer and take up permanent residence.

Pioneers 10 and 11 are in an entirely different category. They might best be described as spaceships without a solar system to come home to. Pioneer 10, for example, zipped past Jupiter in December 1973 at a velocity of 81,000 mph. Its speed, coupled with the slingshot effect of Jovian gravity, will take it out of the solar system towards the star Aldebaran. The journey will take 1.7 million years.

Pioneer 11 sizzled past Jupiter in December 1974 at a velocity of 107,000 mph.
Its speed and Jupiter's gravity whiplash altered its path toward a rendezvous with ringed Saturn in September 1979. Scientists are presently trying to decide whether the spaceship should be guided past Titan, a moon of Saturn, or between the planet and its colorful and mysterious rings. The mid-course correction maneuver, when it comes, will decide Pioneer II's fate - solar orbit or escape from the solar system.

SURVEY TO EVALUATE THE
CALGARY CENTENNIAL PLANETARIUM
by Sig Wieser, Calgary Centennial Planetarium

The Centennial Planetarium in the desire to best serve the citizens in the Calgary area conducted a market survey to evaluate its image, services and programs. The main objectives were to discover people's attitudes toward the planetarium in general and to gauge the effectiveness of the services offered. The survey was carried out in three phases, each phase of the research acting as control upon the other.

Phase I consisted of a telephone survey conducted by trained interviewers of randomly selected respondents in the city. The calls were spread out during the day and evening randomly covering all city areas.

Phase II consisted of a mailer in which known patrons were sent the same questionnaire as used in Phase I.

Phase III consisted of face to face interviews at the planetarium itself.

The three phases were then compiled and correlated.

Visiting frequencies:

- **Zoo** (2,600 seats): 92.5% have visited on the average 6.5 times per year
- **Heritage Park (Pioneer Village)**: 87.9% have visited on the average 2.5 times per year
- **Planetarium**: 85.5% have visited on the average 4.6 times per year
- **Glenbow Museum (Ethnic & Art)**: 57.0% have visited on the average 1.6 times per year
- **Theatre Calgary (professional)**: 41.5% have visited on the average 3.9 times per year

Comparison by Sex:

- **Males**: 63% Patrons 37% Non Patrons
- **Females**: 55% 45%
Comparison in Marital Status:

<table>
<thead>
<tr>
<th></th>
<th>Married</th>
<th>Non Patrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td>Single</td>
<td>63%</td>
<td>37%</td>
</tr>
</tbody>
</table>

Years of residency:

<table>
<thead>
<tr>
<th></th>
<th>Patrons</th>
<th>Non Patrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 1 year</td>
<td>5%</td>
<td>16%</td>
</tr>
<tr>
<td>Under 5 years</td>
<td>18%</td>
<td>28%</td>
</tr>
<tr>
<td>Over 5 years</td>
<td>82%</td>
<td>72%</td>
</tr>
</tbody>
</table>

Popularity with children:

<table>
<thead>
<tr>
<th></th>
<th>Popular</th>
<th>Non Popular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popular</td>
<td>63%</td>
<td>43%</td>
</tr>
<tr>
<td>Not popular</td>
<td>17%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Occupation:

<table>
<thead>
<tr>
<th></th>
<th>Blue Collar</th>
<th>White Collar</th>
<th>Professional</th>
<th>Self-employed</th>
<th>Unemployed</th>
<th>Student</th>
<th>Housewife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Collar</td>
<td>20%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Collar</td>
<td>17%</td>
<td>7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>8%</td>
<td>7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>1%</td>
<td>1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>9%</td>
<td>17%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>3%</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td>44%</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rating of Advertising (Advertising budget is about 8% of total budget):

<table>
<thead>
<tr>
<th></th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Never seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate</td>
<td>27%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>56%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Never seen</td>
<td>17%</td>
<td>41%</td>
<td></td>
</tr>
</tbody>
</table>

Presentation rating:

<table>
<thead>
<tr>
<th></th>
<th>Adequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyed and returned</td>
<td>40%</td>
</tr>
<tr>
<td>Enjoyed and not returned</td>
<td>42%</td>
</tr>
<tr>
<td>Not good enough</td>
<td>18%</td>
</tr>
</tbody>
</table>

Motivation:

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspaper</td>
<td>26%</td>
</tr>
<tr>
<td>Radio</td>
<td>7%</td>
</tr>
<tr>
<td>Television</td>
<td>9%</td>
</tr>
<tr>
<td>Newsletter</td>
<td>3%</td>
</tr>
<tr>
<td>Recommendations</td>
<td>25%</td>
</tr>
</tbody>
</table>

Reasons for not being a patron:

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didn't know there was one</td>
<td>4%</td>
</tr>
</tbody>
</table>
Never seen advertising 10%
Not interested 13%
Haven't gotten around to it 57%
Planning to go soon 17%

Most often made comment: More advertising needed
Nicest comment: Staff is great
Most pertinent comment: How much astronomy can a guy stand
Most irrelevant comment (?): A nice questionnaire
Most frustrating comment: Visits should be compulsory for all schools
Most hurting comment: Staff gave incorrect information about Kohoutek

The survey arrives at a customer profile, which allows the targeting of more effective communications with the community. It further provides a wealth of ideas and suggestions to be tried in the planetarium operations. Among these a multiple program availability scheme which may look like this (scheduled for August 1976):

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>2:15</td>
<td>Star Doc (life and death of stars)</td>
</tr>
<tr>
<td></td>
<td>3:30</td>
<td>Serendipity Show (serendipitous discoveries in astronomy)</td>
</tr>
<tr>
<td></td>
<td>7:15</td>
<td>Space Puzzles</td>
</tr>
<tr>
<td></td>
<td>8:45</td>
<td>Last Question (Science Fiction)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>2:15</td>
<td>Star Doc</td>
</tr>
<tr>
<td></td>
<td>3:30</td>
<td>Stars and Things (grass roots astronomy)</td>
</tr>
<tr>
<td></td>
<td>7:15</td>
<td>Lost Horizons (measuring distances)</td>
</tr>
<tr>
<td></td>
<td>8:45</td>
<td>Archive Factor (Science Fiction)</td>
</tr>
<tr>
<td>Thursday</td>
<td>2:15</td>
<td>Star Doc</td>
</tr>
<tr>
<td></td>
<td>3:30</td>
<td>Space Puzzles</td>
</tr>
<tr>
<td></td>
<td>7:15</td>
<td>Stars and Things</td>
</tr>
<tr>
<td></td>
<td>8:45</td>
<td>Archive Project (Science Fiction)</td>
</tr>
</tbody>
</table>

- etc., etc., -

IN VOLVING SCHOOLS IN ASTRONOMY

By H. D. Teuscher, (MAPS Newsletter)

After three days of discussion and exchange with two consultants who visited the Virginia Beach Planetarium installation - namely Linton and Phyllis Pitluga of Chicago fame - it came to light that many new approaches are possible regarding involving area schools more meaningfully in the Astronomy - Space Science Program.

One of the things often neglected by planetarium directors is visiting the
various schools he or she serves. For those of us with more schools in a division than we can possibly serve in one year, this becomes a problem. Thus far, in Virginia Beach there are 37 elementary schools and 14 secondary, totaling 51 schools. Regardless, the decision was made to try some new approaches to involve first one school, and depending on the outcome, maybe two or three each year thereafter. The number of approaches to involving schools far exceeds the amount that can be applied at one time—realistically. Of the many exciting possibilities discussed, we formulated a loosely structured plan to incorporate as many ideas as possible that would benefit the schools in Virginia Beach, Virginia.

Once an outline of the intended program was completed, a meeting was arranged with the elementary supervisors in order to review the outline, and allow for input. At the conclusion of the meeting, it was agreed to try the project at an elementary school with the idea of involving all departments of the school in an Astronomy Month. The supervisors were to select a school for this pilot project.

A meeting was arranged with the principal of the selected school to set a date to meet with the faculty to present the plan for their approval.

At the first meeting with the faculty, a five-minute slide-tape show telling the story of the planetarium was presented. Next, each teacher was given a current newsletter containing information on the positions of the planets, phases of the moon and meteor showers for the coming weeks. Teachers were also given lists of programs available for every grade level in the planetarium.

The idea of involving all departments in the school at the same time in focusing on studies in space science and astronomy was presented. At the same time, actual mechanical and visual aids were presented on loan to them that afternoon for their use. Items included: bibliographies of astronomy books, NASA pamphlets on "Food for Space Flights," space posters, astro-murals, four cassette tapes of music about the planets and space, teachers' guides for all grade levels, including follow-up activities that can be used in the classroom, a series of nine laboratory exercises designed for the classroom, 15 short TV-clip movies from NASA, a model of a Saturn-V rocket, and the promise (which was fulfilled) of three four-inch reflecting telescopes. A two-week time block for planetarium visits was set aside just for the project school.

Also, the total cooperation of the Virginia Beach City Schools Instructional Media Center was announced. At a previous meeting with the planetarium director, the director of the Media Center agreed to give priority to requests from the school to make the project a success. Special lists of films, filmstrips and kits on astronomy and weather were assembled and made available to teachers. The Media Center established a special two-week loan period to allow articles to remain in the building for that period of time. Several space music tapes were copied onto cassettes which were placed in the school library for use of the faculty.

The decision was left up to the faculty as to whether or not they would become involved in the program, and if they did, it was their decision as to how many departments to involve.

A few days later, word was received that most of the faculty chose to be involved in the program. Also, the principal had appointed a committee to help
coordinate the project. Two weeks later, another faculty meeting was held where the planetarium director presented an in-service on the use of the celestial globes loaned to the schools. Also, instructions on how to present two labs (chosen by the teachers) to students was accomplished.

The following week, Dr. Charles Smith on the staff of the Virginia State Science Museum in Richmond, arrived with the science mobile unit, Trans-Science 1. The mobile unit was parked in the yard of the school for two weeks. All grades whether involved in the astronomy project or not, toured the mobile unit. It was also visited by area schools, and was open to the public two evenings the second week. The mobile unit contained a Laser, a Geiger Counter, a model Viking, a model Skylab, a model ERTS satellite, satellite photographs of Virginia and Chesapeake Bay, a mini-planetarium with satellite orbits that can be seen from Virginia Beach and a display on the future Science Museum of Virginia buildings and grounds.

Arrangements were made with the Public Information Office of the school division to send a photographer to the school to take a series of photographs of the various events. A list of suggested pictures was agreed upon by the planetarium director, two faculty members and the principal. A photographer from the Media Center agreed to take color slides of the project. Thus, we had a set of 8 x 10 black and white photos sent to us by the Public Information Office, and a set of color slides from the Media Center. The black and white photos will be used in any new brochures or flyers we may print. The color slides will be used in a slide-tape presentation of the project for other schools.

As the project evolved, many interesting drawings and works of art appeared from different classrooms. Drawings papered the hallways, and an exhibit of science projects was held in the main entrance hallway of the building. The planetarium received many of these projects to fill and decorate a main showcase within the planetarium.

One evening a star party was held in the parking lot of the school. Three four-inch reflecting telescopes were set up in the school yard to view Venus, Saturn, the Moon and some double stars.

A wrap-up meeting was held with the school project steering committee, the principal and the planetarium director. We all generally agreed that April was too late in the year for a project of such scope, as many classes had already the astronomy part of their science lessons. However, April was a good month as far as "giving a shot in the arm" to the elementary studies. It was also agreed that the faculty and students received the project with enthusiasm, and gave it their best efforts.

During the last week of school, the black and white photographs taken at the school were displayed in the corridors. The slides were set up on the stage of the combination auditorium-cafeteria and projected on a rear-screen on loan from the planetarium. The slides were on display the last two days of school so students could view them while they ate lunch.

CONCLUSIONS AND RECOMMENDATIONS:

It was concluded that in the future any school involved in the project could
benefit by more advance notice. Grade level meetings should be held for better communication, a two-week time block should be set aside for each participating school at a different time of year (preferably in the winter), a theme should be established, more evenings for observation should be included. Also, with time for advance planning, better use of materials at the Media Center is a goal.

For a project that had its inception in March, and was realized by June, we were pleased. We know we can do better, but we also know it works. Involving the schools increased planetarium traffic considerably. From working in person with the faculty and students in the school, a much better understanding of the planetarium, its functions and services was established. More faculty members made use of the services of the planetarium. Traffic for that month was increased by about 2000.

The faculty has already chosen the month they want to engage in the project for next year.

TO ANY CRITICS WHO ARE LISTENING

by David A. Rodger, H.R. MacMillan Planetarium
Vancouver, B.C., Canada

I certainly do not envy a person who has to evaluate a planetarium show, especially if he has to write about it for a newspaper. So much depends, after all, on the standards by which the planetarium and its shows are judged. The first problem is that the critic, whether professional or amateur, has probably not seen another planetarium. Many patrons are still visiting our planetariums for the first time, so they can't properly compare what they see with anything similar. Some will judge the show by motion picture standards. This is understandable because, in a planetarium show, images are projected on a screen. Yet the use of cinema in a planetarium is minimal; the whole configuration of screen and audience is wrong to a cinematic experience, not to mention the astronomical costs of projection equipment of this kind needed to pleasingly cover the thousands of square feet on a curved screen (The people in San Diego and Tucson can attest to that). The planetarium is simply not a motion picture theatre, and it cannot do many of the things film-viewers take for granted.

Some people who attend the planetarium, would evaluate the presentation as a lecture. For them, it would seem that the experience might lack depth and academic content. Moreover, surely it would be annoying to have the lecture cluttered up with fancy lighting, music, and sound effects. As for those who seek pure entertainment, the experience would again be disappointing, but from the opposite point of view. Too much content!

I suppose that if the planetarium world deserves some blame, it may be for not spending enough time explaining our medium, its purposes and limitations. Heaven knows, many of us have committed a good deal of time and money to the publishing of a comprehensive souvenir guide booklet, and, at MacMillan, we devote at least some of the time following each public show, pointing out the various technical facilities and techniques at our command. We have been taken to task for that, by people who feel that we have spoiled the illusion by letting them in on
some of the planetarium magic.

One of the most constant, and for us (as creators of the planetarium medium), bewildering, criticisms, comes from people who think we are not using the star projector, be it a Zeiss or a Minolta or whatever, to its full potential. It is a marvelous machine and it does what it is designed to do extremely well. But, it is, in astronomical terms, a "celestial sphere" projector and nothing more. For most of the fifty years of the planetarium projector's existence, that machine was all anyone really wanted to see. The people who operated it tended to be, in most cases, ones who were used to lecturing in universities or institutes, so planetarium presentations were really little more than sparsely illustrated lecture-demonstrations. And that isn't a value-judgement! Some extremely good lecturers came out of the era of live planetarium presentations.

Consider, for a moment, the kind of room in which we find one of these machines. A circular hall is always impressive to the eye, and one surmounted by a hemispherical dome can be even more so. However, circular projection surfaces are notoriously difficult to deal with, so I think I am safe in saying that if it were not for the necessity of reproducing the night-time sky and its associated motions in a natural way, the circular theatre and overhead dome would have passed into history along with horse-drawn trolleys, stereo-opticans and Victrolas. As a matter of fact, if the Star Projector had not been invented yet, I doubt that it ever would be. There are now other ways through which to communicate astronomical knowledge; ways that are somewhat more convenient to operate and to enjoy. We must never forget that the Star Projector Planetarium was invented in an era before wide-screen movies, multi-media, and television.

During the 1960's, a number of planetarium people began to think in terms of broadening the scope and potential of the planetarium by borrowing techniques from other media. In order to deal with topics beyond the visible sky and, therefore, beyond the capabilities of the Zeiss projector, it became necessary to introduce slide projectors for still pictures, lighting for colours, reasonably sophisticated sound systems, special effects devices capable of reproducing all kinds of astronomical phenomena, and even automated sequencing equipment to help co-ordinate it all. One of the most traumatic changes, which has still to be widely accepted in planetariums, was the introduction of recorded sound tracks. Old lecturers die hard, it seems!

But in doing this, the planetarium was inadvertantly intruding into the realm of show business. And, in a sense, it was as if a young bird, having mastered the art of flying, aspired to become a jet aircraft! Some planetarium people failed miserably. Others were more successful and found a convenient bridge between education and entertainment in a kind of mixed-media documentary presentation on astronomical themes.

The surest way to duck public criticism would be to withdraw into the shell of celestial sphere astronomy, exclusively, and present lecture-demonstrations. That would lower both audience expectation and patronage but we would be being true to our medium and what it was really designed to do. In that way, by pulling back from the world of entertainment, no ill-formed critic would dare to expose his lack of astronomical knowledge by commenting upon our shows. But we won't do that, I'm sure!

THE PLANETARIAN, 6/76 25
So what advice do I have for the would-be critic? First of all, if you're going to write about the planetarium and astronomy, I suggest you get thoroughly familiar with both subjects. The planetarium is in the public-interpretation business, and you're going to have to evaluate the success of our brand of interpretation. Certainly a tone-deaf music critic would be laughed out of town. A person who tried to review a play with no prior knowledge of the theatre would probably write a very peculiar review. After all, why are all those strange people living in a house with only three walls and a bare floor, where everyone can watch them? Sound ridiculous? That's the kind of level that has been reached so far in a lot of published commentary on the planetarium.

As I say, we, as planetarians, deserve to be reviewed on our ability to interpret astronomy in a planetarium. To that end, I would strongly urge our daily newspapers to send their critics across Canada to see many planetariums (there are only six). Perhaps some of us are not as good as we think, and perhaps we're not as bad as some others think either. But that is the only way one can tell. We shouldn't be judged by the wrong standards.

Meanwhile, I suggest the Planetarium Community continue to experiment with new techniques and topics for presentation. Variety in public programming, music concerts, and light shows are all being worked on everywhere on this continent. Let's not be afraid to experiment. We are in the planetarium business and I am sure we intend to continue that way.

And if any critics are listening, give us your best ear!

HOW TO MAKE IT
An Adjustable Projector Stand
by E.Q. Carr

We determined that summer was the time to replace the miscellaneous rubble piles of cardboard boxes, 2 x 4's and plywood scraps used as projector stands in our projection bay, with something better. The drawing (following) illustrates a stand within our skill and tools - a hammer, handpower saw, pistol drill and hacksaw. The total cost for 16 adjustable projector stands came to $16.72 at the local lumber yard.

The unit consists of a 5/8" chipboard base to which 1 x 3" drilled legs were glued and nailed. The legs were drilled with a series of holes 5/16" in diameter on one inch centers. A 36" piece of 5/16" - 18 continuous threaded rod was cut into 2-inch pieces for these holes. These rods (or 2" long 5/16" - 18 bolts) support the actual projector base at any angle, looking up or down. The base has a single 5/16" wide by 1/4" deep groove cut across the base to fit the threaded rods.

We actually made more than 16 bases, some were 5 3/4" wide to accommodate the 20 single projector.
School shows at the H.R. MacMillan Planetarium in Vancouver have extremely short runs. While we may bring a show back for a week at a time for several years, we like to offer a great variety of programs in any one month. Shows may run for as few as three days at a time if they are computerized in our lighting system, or, as one show at a time if they do not require computer control.

It doesn't matter what grade level we're dealing with, invariably most of the shows will, in whole or in part, deal with planets. Still slides simply do not convey the impression of motions of the planet. The extreme dynamics of a dust storm on Mars or a hurtling red-spot on Jupiter lend themselves more to animation or special effects. If effects production is limited by deadline or money, any use of film is out....leaving only a special effect.
Our technicians set out to build just such an effect. It had to be inexpensive to build; it had to be simple to construct; and it had to have the capacity to depict several planets to a relative level of scientific accuracy.

The basic projector chosen was a single slide Pradix projector although any equivalent projector would do. The Pradix has the feature of a removable slide carriage assembly. Between the condenser and bulb, and the projection lens, there is over one inch of useable space. We modified the existing Pradix so that a 150 watt Quartz-Iodide bulb could be used. This is required to project a bright enough image in a large dome, or where the transparency is very dense. (Diagram 1)

On one side of the lens housing, a synchronous motor and bracket were mounted. The motor chosen was a 1 r.p.m. speed, 110 volt. A two-pronged male Jones plug was attached to the motor leads. A female receptacle was wired directly from the lamp voltage in the back of the projector. This allowed a quick motor change from show to show.

The motor shaft extends over the opening normally occupied by the slide holding carriage. It is parallel to the light path and about three inches away from it. Next we produced 7" diameter clear plexiglass circles, each perforated with a central hole that would accommodate the motor shaft.

These plexiglass circles would represent the planets surface....as seen in polar projection. The northern portion of the planet would be represented by the outer circumference of the circle (the inversion of the optical system makes North at the bottom), and the inner portion would be the planets Southern extremities. (Diagram 2)

To insure that the final planetary image is circular (a square, rotating planet is not acceptable), a fixed circular mask can be installed behind the plexiglass disc. This effectively reduces the amount of light projected. If this light loss is a problem, an alternative method of forming the circular shape involves installing a fast condenser lense immediately in front of the plexiglass. This second method, though somewhat more complicated, does produce a better image. The image takes on a spherical three-dimensionality, and it exhibits limb darkening.

Depending upon the quality of the art work on the discs, any of the planets can be produced. The detail required to produce discs for Mercury, Earth, or Mars, make these planets the most difficult to produce. Venus and the gas giants simply require finger painting techniques. The disc is then projected slightly out of focus to produce cloud tops, bands and belts, the red spot, or....Superimposition of a still slide of the rings of Saturn onto a rotating Saturn makes a very worthwhile effect.

When you're painting the discs remember, you're painting in negative. If you want an area projected light, you paint it less than an area that is to be dark. And also remember, the area of the disc that falls in the cone of light represents half the planet (one hemisphere). Around the circumference of the disc you should show at least 3 or 4 complete equatorial images. (see Diagram 2).

Give it a try. It's simple, it's quick. It's effective. And, it's inexpensive. (Diagram 3)
1. Pradix Slide Projector
2. Lense Housing.
4. Synchronous motor.
5. Heat absorbing glass.
6. Motor 110 v. leads to bulb.

7. Unuseable area.
8. Field of view of lense (light cone.)
9. Motor shaft hole
10. the Red Spot.
1. Pradix projector.
2. Synchronous motor.
3. Plexiglas disc.
4. Lense (3–10 inch)
5. Condenser lense to produce circular image, or ....
6. Circular mask on glass.
The Star Bow Projector
by E.Q. Carr

We needed an effect to cover the description of the idea that at speeds approaching the speed of light, a narrow star bow of true color stars may appear overhead with blue shifted stars ahead and red shifted star behind the space traveler and his ship.

It's a 2# coffee can project naturally, with a 20 watt light source. The can should be painted dull black inside and out after cutting a 3" wide slot x 180° around the can. Center the slot equidistant from either end.

Across the slot place a prepared cover of aluminum foil about 5" x 9". The foil should be prepared by punching holes on a hard surface with a needle after preparing a sandpaper background of stars. The aluminum foil should be prepared by sandwiching the foil between two sheets of a very coarse sandpaper and pressed in a heavy book. Mount the foil with black masking tape.

Paint the ends of the foil about 1" from each end in a very light coat, red and blue translucent lacquer. When dry, paint additional layers toward the edge to get deeper red or blues.

Our star bow projector was mounted on the planetarium cove with the bracket bent as shown.
Moon Images
by E.Q. Carr

Behind the dome, moon images can be made with a coffee can and a 15 watt lamp. For our program "The Thirteen Moons" on Indian mythology of the moon, the coffee can illuminator shown in the accompanying figure was used. The moons are across the dome, held with sticky tape and wired to a stepping switch. Number 18 conductor zip cord is more than adequate for 15 watt lamps.

The trick we used to get moon images at minimum cost was to make Xerox copies (from our Minolta copier). From various books, we were able to find different sizes of moons.

To match our own size moon, we required an 8.5 cm diameter. For a more dramatic impact, we made them larger, 14.5 cm in a 3# (or a #10 food can) coffee can.

<table>
<thead>
<tr>
<th>Can</th>
<th>Diameter (Apprx.)</th>
<th>Moon Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1# coffee</td>
<td>9.8 cm</td>
<td>5.4 cm, 5.5 cm (See notes 1,2,3)</td>
</tr>
<tr>
<td>2# coffee</td>
<td>12.5 cm</td>
<td>9.4 cm</td>
</tr>
<tr>
<td>3# coffee</td>
<td>15.2 cm</td>
<td>9.4, 14.5, 17.5, 18.2 cm</td>
</tr>
</tbody>
</table>

Notes:

1. Lafousse Encyclopedia of Astronomy - Rudaux and De Vanconleure, Paul Hamlyn London 1962 Fig. 263 (14.6 cm), Fig. 249 (6 figures of phases, maximum 5.5 cm)
2. A New Photographic Atlas of The Moon, Zdenek Kapal, Taplingler Pub. Co., New York 1971: pg. 17 Fig. 6, 9.4 cm (inner image), Figure 5, 2 each, 5.4 cm

If the image is too dim for your planetarium, a larger can and larger lamp may do. Alternatively, Kodalith transparencies would probably be satisfactory. A quick fix that could get a bright image is to dip the paper copy in an oily bath of mineral oil, although I'd bench test that setup in a fire proof surroundings to check the fire hazard.

We used black construction paper around the moon image with a hole cut to 14.4 cm in diameter and a judicious amount of black masking tape.

The idea has obvious extensions, all moons can be lighted simultaneously, phasing masks can be added, the moons or Mars could be sequentially lighted to give an appearance of motion across the dome with an image revealer to give the flight path of a moon bound vehicle to a planet.
MOON IMAGES
1/16 EQ. CARR

CENTER LIGHT SHIELD

MOON IMAGE

COFFEE CAN

CENTER LIGHT SHIELD

15W SOFT GLOW INCANDESCENT LAMP

LINE CORD

LAMP SOCKET

PLASTIC COVER CUT-OUT FOR MOON IMAGE