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Volume 15, Number 2
Second Quarter, 1986
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**INTRODUCTION**

It is probably safe to say that there are as many approaches to producing panoramas as there are planetariums using them. Likewise, panorama projection systems can range from simple brute-force devices to complex multi-projector arrangements operating under computer control. Despite the general lack of standards for the panorama format, however, most photographic panorama production has one common feature: the original panoramic scene will at some point lie under the lens of a ‘copy camera’ to be rephotographed into one of a number of different projection formats being used in planetariums today.

Although a variety of innovative methods have been developed to facilitate the production of planetarium panoramas from painted flat artwork (custom jigs to minimize distortion, special preparation methods and so forth), relatively little attention has been paid to photographic techniques for producing the original panoramic image. This is not really too surprising, since many planetarium programs call for landscapes of alien worlds, scenes from the past or future, and other types of imagery that are not easily captured by on-location photography.

Every planetarian, though, is at one point or another faced with the problem of creating a panorama of the real world that only on-location photography can provide. In the following, we will look at several different ways to produce high-quality, continuous image photographs using the modern generation of lightweight, portable panorama cameras. The wide-format panoramic image generated by these cameras can then be rephotographed for projection with a copy camera in much the same fashion as conventional painted art work prepared by the planetarium artist.

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**Slit-scan cameras can record a continuous image of 360 degrees . . . appropriate for horizontal domes with projection systems that completely surround the audience with an image.**

**PANORAMIC CAMERAS**

There are two basic types of panorama cameras manufactured today—fixed-lens, fixed image plane, wide angle cameras and rotating slit-scan systems. The panorama cameras equipped with fixed lenses and wide image planes can reproduce a wide field of view, with little distortion, on a stationary piece of film. This type of camera works well with panorama projection systems of 180 degrees or less, and an aspect ratio (ratio of image height to width) of up to 1:6. This is typical of planetariums that incorporate a tilted-dome and/or unidirectional seating configurations.

The more complex slit-scan systems are generally more expensive than the fixed-lens type cameras, but offer the maximum in imaging potential. These cameras can record a continuous image of 360 degrees, making them more appropriate for horizontal domes with projection systems that completely surround the audience with an image. Both types of panorama cameras, however, are well suited to the planetarium application, in that they produce a high resolution, wide-format photographic original that can be duplicated and projected with excellent results.

At Spitz Space Systems, we had the opportunity to evaluate the following cameras: the Fujica G 617, a fixed-lens, wide angle camera; the Hulcherama Model 120 panoramic camera, one of the more sophisticated slit-scan devices; and the Globuscope 1000, a relatively economical 35mm slit-scan camera. While there are other panorama cameras on the market today, these three are representative of the basic range of commercially available systems.

**FUJICA G 617**

The Fujica G 617 is a stationary camera with an ultra-wide image plane. It produces a 6 by 17 cm. image on a section of 120 or 220 roll film, providing four or eight exposures, respectively. The camera employs an EBC Fujinon SW 105mm f/8 six element lens (with a horizontal angle of
view of approximately 77.3 degrees) and incorporates a direct viewfinder system. Shutter speeds range from B (time exposure) to 1/500 second; aperture settings range from f/8 to f/45, offering excellent depth of field.

The image produced by the Fujica G 617 has an aspect ratio of about 1:3, about three times as wide as the conventional square 6 by 6 cm format. The image can be “widened” even more to meet the specific projection requirements by cropping top and bottom in the re-photography process. The ultra-wide format and large size of the original negative ensures a high quality, high-resolution image, even when duplicated and projected in large domes. The camera measures about 11" wide by 6" high by 8" deep and weighs about five pounds. Cost is approximately $3,000.

HULCHERAMA 120 PANORAMIC CAMERA

The Hulcherama 120 is one of the high-end slit-scan type panorama cameras. The Hulcherama photograph is essentially a cylindrical section of everything that can be seen from the camera location (Figure 1). Panoramic pictures are produced by rotating the slit-scan camera counterclockwise, by means of a small DC motor. As the camera rotates, the light from the lens passes through an adjustable slit onto the film, which also moves past the slit, to form a continuous image on the film. While the slit-scan camera has no shutter to speak of, the combination of six rotational speeds (2, 4, 8, 16, 32, 64 seconds) and four slit widths (1/4, 1/8, 1/16, 1/32 inch) provide effective shutter speeds ranging from 2 seconds to 64 seconds. As in other types of photography, the smaller the lens aperture, the greater the depth of field.

The Hulcherama 120 uses standard 120 or 220 roll film, providing three and six complete 360 degree images, respectively. The camera is equipped with a 35mm focal length f/3.5 lens, which provides a 79 degree vertical by 360 degree horizontal picture on approximately 23 cm of film. The image has an aspect ratio of about 1:4 for a complete 360 degree exposure. A newer version of the camera produces a 360 degree image on about 46 cm of film, yielding an aspect ratio of about 1:8. The camera may be set for an automatic 360 degree rotation, or operated manually for smaller coverage. Continuous rotation of the camera is also possible, such that a complete roll of film may contain a single exposure. The Hulcherama 120, with lens, measures about 6" high by 5" wide by 9" deep and weighs about five pounds. Cost is about $4,000.

GLOBUSCOPE 1000

The Globuscope 1000, like the Hulcherama 120, is a rotating slit-scan camera, although it looks unlike any camera most of us have ever seen. The Globuscope 1000 uses standard 35mm film, as opposed to the larger formats of the cameras mentioned above. The camera consists of a stainless steel body, with an aperture slit, that houses a rotating 35mm camera. The camera employs a unique spring-loaded, fluid drive system that rotates the panoramic head. A six element 25mm f/3.5 lens provides a vertical field of view of approximately 51 degrees.

The Globuscope 1000 records a complete 360 degree image on about 18 cm of film, which is slightly larger than four regular 35 mm frames side-by-side. With effective shutter speeds of 1/40, 1/100, 1/200 and 1/400 second, the camera can operate in a wide range of conditions. Because of its compact size (about 9" high by 5½" wide by 3" deep) and light weight (about 3½ lbs.), the camera can be used hand-held very easily. While the Globuscope 1000 produces pictures of generally good quality, the 35mm format has inherent limitations in terms of sharpness and resolution. This is especially evident in the highly enlarged, re-photographed, final projected image. The cost of the Globuscope 1000 is about $1,500.

THE QUESTION OF FORMAT

Once the original image has been recorded, it must be re-photographed in the appropriate format for projection in the planetarium. As mentioned previously, however, many different panorama projection formats are currently used by the planetarium community. The projection format (number of projectors; amount of overlap, if any;
angle of coverage) determines the specifications for the copying process and the number of segments into which the original will be divided. This must be worked out by each planetarium on an individual basis.

Some planetariums utilize a multi-projector "butts­seam" format, in which the panorama is re-photographed into a series of separate images. When projected, the hard edge of one image is butted to the adjacent image. This approach provides maximum coverage with a minimum of projectors, but even a small amount of misalignment or distortion (which is inevitable) will make matching the edges to achieve a seamless, continuous picture very difficult.

Other planetariums have adopted techniques developed by the multi-image industry. These new methods produce seamless, wide-screen panoramas using overlapping, multiple projector arrangements. The original panorama is rephotographed into a series of separate images, which typically overlap one another by 25 or 50 per cent. Each image is sandwiched in a slide mount with a "soft-edge" mask, which is smoothly graduated from transparent to opaque. The soft-edge masks cause the separate images to blend together into a composite scene without noticeable transitions. This approach can yield high-quality results, but it does increase the number of projectors necessary to cover a given area on the dome. In general, though, very good results are being achieved in both horizontal and tilted domes.

In a Spitz tilted-dome planetarium, for example, the panorama projection system consists of seven dissolve pairs of slide projectors, arranged in a four full-frame/three overlap-frame soft-edge format (Figure 2). This provides a seamless image area of approximately 160 degrees in azimuth and 27 degrees in altitude. The projectors are equipped with 70–120 mm zoom lenses and are mounted in racks that permit precise adjustment and fixed alignment of the projectors.

In our tilted-dome planetarium, the panorama projection system consists of seven dissolve pairs of slide projectors, arranged in a four full-frame/three overlap-frame soft-edge format.

To translate a Fujica original (aspect ratio 1:3) into this projection format (aspect ratio 1:6), 50 per cent of the vertical dimension is cropped to allow the full expanse of the horizontal dimension to be seen. The original panorama is then copied as a series of seven overlapping, pin-registered frames. Although the original panoramic photograph represents about 77 degrees of the real world, it can be reproduced on the planetarium.
dome as a 160 degree image with surprising realism and natural perspective, depending, of course, on the subject matter of the photograph. For most applications, especially landscape photography, this is not a problem.

The 360 degree slit-scan cameras can produce even more literal results: a life-like perspective can be created by re-photographing a section of the original panorama equivalent to the angle of coverage of the projection system. For example, a 180 degree section of the original slit-scan image could be reprinted for a 180 degree projection format, while a continuous 360 degree section could be reprinted for systems providing a 360 degree wrap-around image. Thus, it is possible to photographically render the real world and reproduce it in the dome in a faithful fashion.

MASKING THE PANORAMA

Adapting real-world panorama photography to planetarium applications is complicated by the need for totally opaque backgrounds above the perceived horizon. Several masking techniques can be employed, but a particular method should be selected prior to location photography, as the choice of film stocks (transparency or color negative) is made on this basis. Not surprisingly, all methods have their particular strengths and weaknesses, benefits and trade-offs.

If the original panoramic photograph was shot on slide film, the re-photographed 35 mm projection duplicates (typically made on Ektachrome dupe stock) can be used to generate Kodalith masks. In the time-honored planetarium tradition, the 35 mm dupe is projected onto an easel/jig and the unwanted image area is outlined and inked in black on white tracing paper. This black and white art is then photographed in register on Kodalith high contrast film, yielding a mask which can be sandwiched in the slide mount with the original (and a soft-edge mask). This method produces an extremely opaque mask and allows the use of first-generation projection duplicates. However, it is somewhat labor intensive and requires that some special equipment be fabricated or purchased.

Shooting the original on color negative film allows a different approach to the masking problem: a large (16" x 20" or larger) "reproduction quality" color print is generated from the original negative. The unwanted image area is blackened with India ink or a suitable marker, either on the print itself or on a clear overlay sheet. This process results in an "original" panorama not unlike traditional painted panoramas prepared on black art board. The panorama is then re-photographed with a copy camera on slide film, using "bi-pack," or double-density, exposure techniques (another innovation borrowed from the multi-image industry).

The bi-pack technique essentially involves making two pin-registered exposures of the same original, the first slightly (approx. 1/2 stop) overexposed and the second about 4 to 5 stops overexposed. When sandwiched together in a pin-registered slide mount, these two film chips will produce a fairly opaque black which a single density of Ektachrome will not. The exposures given here are average starting points only; some experimentation will be required to get good results. While the production process is somewhat simplified when compared with Kodalith masking techniques, one must consider the expense of having a large color print made and the inevitable generational losses in the projected image.

SUMMARY

Panorama cameras, when creatively used, can produce planetarium panoramas with a degree of realism unobtainable by other means. It should be remembered, however, that the original panoramic image, whether it be photographic or air-brush artwork, is subject to the vagaries of the rest of the production and projection process. The quality of the projected image on the dome will depend on several factors, including the accuracy and repeatability of the optical printing system, the projection system and ultimately, on the projection format itself.

SOURCES

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<th>Panorama Cameras</th>
<th>Soil-edge Masks and/or AV Accessories</th>
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<tr>
<td>Charles A. Hulcher Co.</td>
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<td>909 &quot;G&quot; Street Hampton, VA 23661</td>
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<tr>
<td>(Hulcherama 120)</td>
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<tr>
<td>Globuscope, Inc.</td>
<td>WTI Inc.</td>
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<tr>
<td>44 West 24th St. New York, NY 10010</td>
<td>27324 Camino Capistrano</td>
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</tr>
<tr>
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<td>Laguna Niguel, CA 92677</td>
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<tr>
<td>34-11 62nd Street Woodside, NY 11377</td>
<td>Perfect Pan Masks</td>
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<td>Panorama Camera, not reviewed here</td>
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<tr>
<td>Fuji Photo Film Co., Ltd.</td>
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<td>350 Fifth Avenue New York, NY 10118</td>
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<tr>
<td>(Fujica G 617)</td>
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</tr>
<tr>
<td>HP Marketing Corp.</td>
<td>Tampa, FL 33614</td>
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<tr>
<td>216 Little Falls Road Cedar Grove, NJ 07009</td>
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Publications

Audio-Visual Communications
50 West 23rd Street
New York, NY 10010-5205

AV Video
25550 Hawthorne Blvd.
Suite 314
Torrance, CA 90505
I saw it happen once: a solid idea for an audio-visual show originated in a committee meeting. Eight diverse visionaries came to an unanimous agreement on the direction of a motivational program for our facility.

Weeks later, when the finished show was unveiled, the only thought we had in common was our disappointment. Each of us fumed, "What happened by my idea?"

Experience is what you get when you do not get what you wanted.

In this sense, AV communicators may be the most experienced of all professionals, thanks to the perils of the scripting process.

But there was another script that had none of these problems. The client provided sufficient guidance and trust; the producer treated the client and writer with respect; and the writer enjoyed working on what resulted in an impressive and powerful show.

This latter example was a not-so-typical experience of the type of which we all need more. When an image of an ideal appears, we should grab it and pin it down. Better yet, we should screw it down. This article is a model of scriptwriting management that may take effort to install but, once mastered, will save time, money and aspirin.

WHAT'S IN A NAME?

Repeating an ideal requires organization. Although we work for organizations, the word organized is not always considered as a related concept. The two are thought of as different words, as are a foot of 12 inches and a foot of five toes. What is necessary to organize and tone scriptwriting? Perhaps this needs a disciplinarian — a screwdriver.

THE EASY WAY OUT.

One reason why an organization might not live up to its label is that, consciously or not, we tend to avoid commitments. The first choice to be made—or avoided—is whether imposed discipline is better than the current situation. This answer requires time. Operating without discipline may be easier than establishing a new understanding.

GOING FOR THE GOAL.

Organizations create positions of responsibility. Ours is to communicate. The goal of producer and writer is the same: useful information, well presented. Information and presentation conveniently divide into what is to be said and how it is to be said. In some cases, separate territories exist between the information expert and the presentation specialist. The writer is the intermediary, ensuring that the best offerings from each are combined into one effective show.

A central characteristic of creating an AV show is preparation, which cannot be overlooked. Whether we are preparing a video, slide or multi-media presentation, we are readying recorded, persuasive, processed messages.

Between the organization's objectives and the communication solution is the making of the script — five, 30, 100 pages of written copy and instructions. The solution to the problem is only as good as the script. What is emphasized on paper is emphasized on screen, and what is neglected is neglected. If it is long on paper, it will be long on tape. If it is terrible on paper . . .

Our job is to gather and manipulate information into the most appropriate, condensed presentation possible. This is best accomplished with systems of selectivity. How does any system work best? Experience tells us that a system is only as effective as the support that people provide.

CREATING THE BEST MIX.

It all depends on systems and people but, as experience shows, this means "hard" systems and "soft" people — digital ideals implemented by analog beings. Systems may click, but people are supple.
Screwed-down scriptwriting demystifies writing by opening eyes wide and regarding the practice for what it is: more business than creativity; more work than fun; and more a group project than the writer’s individual set of choices.

At the heart of the scriptwriting matter — between people and systems—is choice. Decisions need to be made in a group before the project proceeds. This leadership must do paperwork and concentrate, coordinate and maximize resources. A written plan of action, understood and agreed upon by all involved, aids the success of the final program.

MORE THAN A GAME.

Scriptwriting is problem solving. This writing requires creativity plus a special type of inventiveness. Scripting is a business puzzle: What is the problem? What are some possible solutions? Which is the best? These are as much business decisions as are the many others made in organizations.

Writing a script is less razzmatazz and exhibitionism than it is a long process of organizing, making and recasting business choices. A script must work. Transforming problems into solutions that not only fit on paper but also are viable on screen can be a pressure-filled, difficult operation.

A BALANCE OF POWERS.

If an expert takes too much control, the program may be full of information but poorly presented. Shows with too much “what” and insufficient “how” elicit a “boring” reaction from the audience.

A show with too little information and with too much presentation, perhaps because the producer wanted to experiment with a new trick, often generates the response, “cute.” “Cute,” the audience says, or “unique” or “interesting.”

Ideally, a program should represent the best of both “what” and “how.” This type of a show, graphically displayed by the longest diagonal line in Illustration 1, generates a sincere “wow” from the viewers.

"Ideally, a program should represent the best of both “what” and “how.” This type of a show . . . generates a sincere “wow” from the viewers."
THREAD-BY-THREAD SCRIPTING

Illustration 2 outlines the components of the script-writing process.

--- Objective Defining
--- Information Gathering
--- Script Outline
--- Treatment
--- Rough Script
--- Final Script

ILLUSTRATION 2

Objective defining involves choosing the specific areas of the problem to which media can be applied. The goal’s outline may be: “Let’s produce a program that tells the audience items one, two and three. After viewing, they should know four, believe five and practice six.”

Each of the included steps is important, but selecting a precise and attainable mission for the media may be the greatest. Once the objective is defined, every effort placed into the project will power the message.

Information gathering includes assembling the data necessary for the communication fix. This is the “meat” for the “means.” To ensure a quality presentation, the writer should do his homework before designing the outline.

The script outline is usually the beginning of the audio-visual process. The most important questions to be answered at this stage include:

- What is the purpose of the show?
- Who is the audience?
- What do they already know?
- What is the scope of your message?
- What effect do you wish to have on the audience?
- Where and how will the presentation be used?
- When do you need the show?

Who will be the technical advisors during scripting and production?
Who will give the final approval?
Asking these questions is a way to project (and modify) expectations.

Treatment is the next step. The treatment is the writer’s reiteration of the show’s purpose, its informational priorities and a condensed narrative of the envisioned program. A treatment is the visual description of the show forming in the writer’s mind. Typically, it is four to seven pages that demonstrate approach, sequence, timing and tone. Once this critical step is established, the direction is essentially the solution.

The rough script is the first draft of the shooting script and is a precise organization of information and word choices, usually 20 to 30 pages in length. As rough as it may be, it itemizes content and visuals.

With feedback from the rough stage, a final script — a final shooting script — is drafted.

RUNNING A TIGHT SHIP.

Screwed-down scripting implies a close-ended process: a pre-determined number of stages and a pre-scheduled length for each. Instead of draft one, draft two, draft three, four, five, six ... , the producer and writer work with the understanding that a finished shooting script will be produced in three steps following a script outline.

Also, each stage is given a definite length. A schedule can be established once the nature of the program is known. Here is a typical ‘scripting window’: A treatment is published a week after the outline, a rough draft ten days after treatment; a final script a week after rough; and corrections, if any, a few days thereafter. Time period for approvals are included.

ILLUSTRATION 3

Continued on next page
INTRODUCTION

The 1985 Planetarium Association of Canada Conference in Toronto included a scriptwriting workshop that was repeated at the 1986 Middle Atlantic Planetarium Society meeting. The workshop dealt not only with the abstractions underlying the writing of planetarium scripts, but also with critical reactions to actual scripts distributed to all participants before the workshop convened.

Since I had proposed this "hands-on" style workshop to Chris Sasaki at the McLaughlin Planetarium, Toronto, he asked me to chair the event. We enlisted John Kenny (Senior Producer at the McLaughlin) and Ray Villard (Producer at the Davis Planetarium in Baltimore) to fill out the panel. Each of the panel members first presented 3–5 minutes of introductory remarks concerning our own approaches to scriptwriting.

The exciting part of the workshop, though, began with the script critiques and open discussion. Thirty or so articulate, opinionated planetarians proceeded to disagree with each other in a most gratifying way, with the discussion centering around three scripts chosen for their diversities of style, content, and programming philosophy.

A transcript of that discussion might make a more intriguing article than the present effort. But John, Ray and I share with you below our recollections of our opening remarks; our opinions about how to write a good planetarium script.

It occurs to me that we are frequently inundated with opinions. Much of what passes for "news" in our newspapers and magazines, and on both radio and television, is actually "opinion." It also seems to me that most of this "news" ought to be disregarded by sensible, intelligent creatures attempting to arrive at their own conclusions about the world around them.

Perhaps a new medical procedure is justified. I'd like to propose the "opinion-ectomy," the surgical removal of dumb ideas. "I'm sorry, sir, but you're just too stupid for words, and so we're going to have to remove your opinions."

I know, this all sounds rather elitist to you. After all, who makes the opinion-ectomy decision? Well, let's be fair — you and I can handle it.

Of course, that's only my opinion.

Please feel free to perform your own opinionectomies on the following pieces.

Notice that each expansion is never greater than the last. If each step follows the model of scripting, treatment matters are never in question at the final stage.

The screw is a simple, efficient machine; not a tyrannical control of scriptwriting. Automobile traffic must have been even more hazardous before drivers learned the value of staying on one side of the road. Once people became accustomed to the system, they arrived at their destinations in less time. The system, because it made sense, became second nature and was no longer questioned. A screw demonstrates its greatest purpose when it is being twisted into place. Later, although it may be forgotten, it still accomplishes an important job.

The AV product is only as effective as the script, and the script is only as good as the established system. Making this system understood and appreciated by everyone may be a slow process, but once it is in place, most people would agree: being screwed down is better than up. Experience proves it.  □
A good planetarium script has a logic that is apparent, as well as a flow that feels natural. While it presents facts, it emphasizes the processes of science.

— Francis Biddy

When writing a script, we need to know what our theme is, and emphasize it strongly. If, within that theme, we're telling a story, we need not only to tell the story well, but to relate it to our theme.

We need to write to be heard, not read. And we should remember that the audience will hear our words while simultaneously seeing our visuals and listening to our music.

Who is that audience? It's a truism that the writer should know who the audience is, but very little work has been done in defining our audience(s). If we knew our audience, then we might try to decide how that knowledge should effect our choice of topics and writing styles.

And speaking of topics and writing styles, here are some of my thoughts... science documentaries are great, but why should we limit ourselves to a steady diet of documentaries? The facts are that both science-fiction and humorous shows, as well as plays, concerts and a variety of other special events, can be (and have been) done well in planetariums. Some of them have been successful not only at the box office, but also in their attempts to convey new views of the human experience in astronomy. These "alternative" productions help to maintain public interest in our facilities, and to increase our visibility and appeal in our communities.

In documentaries, we should not limit ourselves to the basics: it may be difficult to convey the joys of gamma-ray astronomy, for example, but it's also important (and probably more important than still another review of the circumpolar stars).

Where do our script ideas come from? That may be the most-asked question at writing workshops, and it's probably the most un-answerable. Certainly, voracious appetites for the solitary joys of both reading and writing help. We've got to read countless books and periodicals just to stay current, and our range of reading material needs to include not only the obvious astronomy journals, but also documentary movies and television programs and a variety of prose and poetry. After all this "intake", the question still remains: where do the ideas for the "output" come from?

Some script concepts come straight from the reading itself. For example, a year-end synopsis of astronomy stories in "Science News" triggered a show about recent discoveries in astronomy (several disparate stories united by the common theme of "1984's hot topics"). Other ideas come from a sort of free-floating musing over my "idea file" (stuffed with clippings, photocopies and handwritten notes), an attempt to see or feel connections between apparently unrelated items. These musings may generate such themes as "things we still don't understand," or "periodic, cyclic events in astronomy."

Whatever our conscious or sub-conscious source of ideas, the task of actually writing still remains, and it helps if we enjoy the process of writing, instead of the state of having written. It also helps, I think, if we remain solitary writers: committees rarely create, but individuals do. And creative work succeeds best, I think, when it remains true to one person's artistic vision. That's not to say that each show should be produced entirely by one person, but that the script should be written by one person. Likewise, the artist doesn't need advisors during the painting process, and the composer (or audio engineer) should be left as free as possible during the creative audio process.

Finally, as with any creative endeavor, it's important to know when to stop.

II. JOHN KENNY

Writing, of any sort, is an art. The craft of the wordsmith is to fashion, from text, environments, emotions and understanding. At its very best, good writing can stimulate, not only the inquisitive mind, but can vicariously arouse all of the senses, images, textures, sounds, smells and tastes.

There are all sorts of techniques that can be used to produce a desired effect, such as similes, alliteration, onomatopoeia and others. But these are just tools. They can be well or poorly used. The key to the skillful use of these tools to produce quality writing is style.
I guess it's like endorsing motherhood, but it bears repeating: a clean, comfortable writing style is the most important ingredient in a good planetarium script. There's no single recipe. The very nature of style is that it is as individual as the writer. It's the muse whispering in your ear that lets more than ink flow from the pen to the page. It's the key which lets that disembodied voice, in the dark star theatre, pass the audience's ears and enter into their minds and hearts.

A script that springs from a blending of the author's personal style, and a careful consideration of what the subject matter itself wants to say will have most of the other attributes people ascribe to good writing: flow, harmony, logic, pacing, vibrancy . . .

"Just as it's important to mentally visualize the slides and effects that illustrate a sequence, it is important to mentally auralize it as well."
— John Kenney

Having said that, let me move on to a few of the prejudices and preferences I have that reflect my style, my approach to the planetarium as a medium, and my understanding of the audience in Toronto.

Overall, I probably fall into the conservative or traditional category. I prefer a documentary approach to script writing, rather than a sci-fi story. It allows me to speak directly to the subject material. There is less chance of confusion on the audience's part between what is fact and what is a plot device, or outright fantasy. It also gets rid of characters that you hear, but don't see, something that always bothers me. Yes, you can use film and video for some sections, but by and large, the characters are voices in the dark. It also avoids the problem of having two focuses, the information and the plot. Usually one becomes subordinate to the other and the result is a disjointed script.

Another problem with sci-fi shows is the danger of trying to do a "Star Wars" type, whiz-bang extravaganza. It can't be done. At least, not as well as Hollywood can do it. It leaves the planetarium open to unfair comparison. There are a lot of things at which a planetarium cannot be excelled. In a highly competitive market like Toronto, I like to do what we do best, and that is produce informative, entertaining documentaries.

That's what our audience expects, and what scores highest in our surveys. This could say that we've pre-selected our audience by the type of program we offer, or that we don't do anything other than documentaries very well, but I don't think so. If people wave Star Wars they go to the movies; if they want comedy, they go to the Improv.

Which brings me to my next point. Comedy is the most difficult skill in acting and writing. I'm wary of it in planetarium shows. Humor works best with a live actor, who can play off the audience. It also works best in a full house, which is rarely the case in planetaria. I've seen and heard jokes in planetarium shows fall flat so flat I wanted to die. A few light moments, tongue-in-cheek aside, and polite chuckles will help a script, but a star theatre show is not and should not attempt to be a sit-com.

There are exceptions to everything I've said. You may be a great comedy writer (which leads me to wonder what you're doing in a planetarium). Fantasy-adventure elements are important in writing for children who cannot yet handle abstract-logical conceptual development. They are interested in the story and learn intuitively and by extension of personal experience. But by and large, for a general adult audience, I like a good narrative documentary.

I don't see it as a limitation. A good narrative needs a story to tell just as much as a sci-fi show, and if you want, you can play "let's pretend" with a narrative. Enough of what a script should not be.

What it should be, to begin with, is informative. Our surveys show that our audience is very interested in, but not very well informed about, astronomy. That's why they come. They want to learn a couple of constellations, and a few new concepts. Research has shown that enjoyment increases when new ideas are presented to an audience.

Up to 3 or 4 major new concepts can be presented in a show, after which overload occurs. I don't avoid astronomical terms either. My surveys have shown a very high comfort level with all but the most complex astrophysical terms, i.e. people may not know the definition of a word like parsec but they have heard it before, on "Star Trek" or something, and they're eager to find out what it means from the context or definition in the script.

I like a liberal dose of "schmaltz" too. The best effect in any planetarium is turning on the stars. The judicious use of romantic prose and poetic metaphor, under a dark planetarium sky, can help stimulate a sense of cosmic wonder. The thing that excites me most about astronomy is its mystical fusion of natural, scientific and philosophical aesthetics. It's an essential part of my writing style and something I hope my audience takes away with them.
Beyond the previous thoughts are the more mechanical considerations in writing a planetarium script.

I believe in good organization; it paves the way for a good script. This means all that horrible stuff your English teachers tried to force into your head. Once a topic is picked, I do a little preliminary research. Next, I form objectives for the show. These evolve into a scene breakdown with major visual sequences and points to be covered.

This all helps focus my research and the ideas that spring up along the way. Some objectives may be dropped and new ones added to replace them. Eventually I bring it together as a storyboard, and begin writing.

Perhaps you have your own method. Whatever it is, a plan like this helps prevent hours of sitting, pen poised, staring at a blank page, or the frustration of writing three sentences and scratching out five.

Pace is important. I like to mix sentence lengths to punctuate thoughts. Sentences should not be too long, since the voice is coming at you in the dark and once it’s gone, it’s gone. You can’t go back and reread it.

I think it is important to let big ideas sink in slowly, either by lightening up the tone for a page or giving a good long music pause. The latter are very important (and I am always accused of not putting in enough).

I find it helpful to write with a narrator or sound quality in mind. Just as it’s important to mentally visualize the slides and effects that illustrate a sequence, it is important to mentally auralize it as well. If I know I want to use a certain narrator to give a certain feel; I try to write with them in mind. (I also tend to choose narrators that read my stuff the way I hear it in my head.)

Visual design is a whole other side of script writing, and the weaker one as far as my own talents are concerned, so I won’t go into too much depth about it. But it is essential. Ideally, the words and visuals evolve together. In my case, the words usually take the first step. That’s OK as long as the visuals keep up. When I write two pages of text and no visual springs up, I figure I’ve lost my focus. The same is true when I get a scene in my head and no words come out. The most important part of visual design is to think in terms of the whole dome as an environmental unit, rather than in terms of individual slides or pans.

Finally, after all the research is done and a first draft script has been written, it is time for the polishing. Edit, edit, edit. Does it follow the story? Is there a logical progression of ideas? Have all your surviving objectives been covered? Does it still excite you to read it? If the answer is yes to all these questions, please tell me how you did it. Otherwise, rewrite, and ask for comments from others.

Swallow your pride and listen to the comments, too. I firmly believe that ruthless editing, though it can hurt, can also turn a mediocre script into a good one. It’s a process of literary survival of the fittest. What results will be a more svelte, trim and vigorous script.

Now I’m going to take all this pontificating to heart, and try to improve my own writing.

III. Ray Villard

In planetariums, everyone has their own special recipe as to what constitutes a “good” show, but here are some general guidelines that apply to almost any planetarium program; ingredients which are as basic to a successful show as milk and eggs are to any recipe.

1. Preliminaries

As a first step, it’s important to clearly define your audience. What’s going to interest them and what’s not? (or, are they really going to sit through a show on the Julian Calendar?) It’s safest to assume a high school level of education — no more. That doesn’t mean the show can’t be multilayered; having visual sequences that excite a five year old as well as nuggets of information to enlighten the Ph.D. The script’s tone should be friendly, relaxed and conversational, avoiding the traps of “talking down” to the audience, sounding too “high-falutin’”, or going right over their heads with a trunkload of technical terms.

2. Focus on a Topic

Once you’ve defined an audience, decide what you want them to experience, both on the intellectual as well as emotional level. What are the key new insights or facts they should take home with them? Outline the specific ideas you want to get across and see if there’s a logical flow from one concept to the next. Build your story from there.

Many a potentially good show winds up on the rocks by trying to cram too much information into 40 minutes, or padding too narrow a topic to fill the time slot. Topic and show length should fit hand-in-glove.

Spend a fair amount of time planning the show’s beginning and end, and tie them together conceptually. A prologue or “teaser” at the very beginning may serve to introduce a mystery or conflict, or simply soften up the audience to your topic.

Ideally, the show should build up to an easily recognized climax which neatly wraps everything together, rather than just running out of steam and leaving the audience staring at a blank dome (until they finally catch sight of the exit sign).
3. Write for the Medium

As you research and develop an outline for the show, it's easy to lose sight of the fact that you must visualize these concepts. A script written as if it were intended for publication rather than presentation results in a show long on narration and short on visuals.

Visual sequences have to be mapped out simultaneously with the script's outline. There is a lot of give and take here, and inevitably some wonderful topics get scrapped for lack of dynamic visuals to support them. However, better that than leaving the audience staring at a Kodachrome graph for 40 seconds, as if it were an eye chart.

No matter how skilled and talented the writer, every script needs to go through several editing reviews. Many a mediocre show could have been trimmed into shape by unloading the . . . excessive verbiage.
— Ray Villard

Planetarium scripts are essentially captions to pretty pictures. Much more detail would be as much at odds with the medium as would be the sight of Dan Rather reading the New York Times on television every evening.

It's hard to lose with a show having a lively pace, and where a scene doesn't last longer than ten or twenty seconds. The show's pace should also speed up and slow down at carefully planned locations. When well-executed, the end result is a presentation that sweeps the audience along on an intellectual journey as well as an emotional roller coaster ride, with peaks, dips and surprise turns.

Shows should also have built-in "breathers", where the narration stops to allow the audience to simply sit back and look at a scene for a few moments.

Deliberate humor also provides a much-anticipated relief for both adult and child. However, it must be handled carefully lest it backfire and completely upset the balance of an otherwise coherent production. Keep the audience's sensitivities in mind, making sure that what's funny to you will be appealing to them. Few things put more of a drain on the show than stupid, tasteless or "in" jokes that consistently bomb, show after show.

4. Edit, Edit, Edit

No matter how skilled and talented the writer, every script needs to go through several editing reviews, preferably with several staff members involved. On a first draft, most writers use more words than needed. Many a mediocre show could have been trimmed into shape simply by unloading the extra weight of excessive verbiage.

While editing, keep in mind Henry David Thoreau's admonition: "Simplify, simplify." This applies to topics as well as sentences. Most of our shows would have been better if they were shorter. Take out the weakest two or three scenes. Keep sentences short, introducing no more than one new idea per sentence. Compress paragraphs into no more than three or four sentences each. Strive to keep the story tight and concise.

Shows easily derail the audience's attention by using an overabundance of technical terminology and jargon. The writer's motive should not be to impress the audience with his vast knowledge and language skills, but simply to inform, excite and enlighten. Use a technical term only when it is more precise in meaning than a commonplace counterpart. Minimize the number of new technical terms introduced. Defining too many new terms eats up valuable show time (or unnecessarily pads a show). In the end, they probably won't be remembered anyway.

Don't feel compelled to bludgeon the audience with an endless stream of facts and figures, which soon blurs into meaninglessness for the common visitor. Avoid the Carl Sagan Syndrome (CSS) of framing everything in "billions and billions." Remember the mockery it got him? The audience is much more receptive to simple, relative comparison and analogies. Example: "Though Earth is 12,756 kilometers in diameter, its atmosphere extends merely 60 kilometers, 1/100th the Earth's radius." vs. "If the Earth were the size of a baseball, its atmosphere would be no thicker than a postage stamp.'

Shows sometimes insert taped quotes from astronomers. Though this can add variety and color to the story, the quotes should be brief and used to vary the pace, rather than serve as a primary means of getting facts across. Since most people don't speak casually with the clarity and conciseness of a well-written script, editing becomes critical. A slightly different approach is to quote from a historical figure instead, using a character voice, and carefully selecting the sentences quoted.

A successful planetarium show is highly visual, thoughtful and entertaining. The experience is so rich, varied and colorful that the audience leaves wishing it lasted longer and wondering how so much show was compressed into so little time! □
Science and Technology are in the news every day. New theories and insights are gained into the universe, the way humans behave and function. The world is changing around us and few outside the scientific professions have an opportunity to participate in and understand these many new ideas and discoveries in a practical way.

TOUCH THE UNIVERSE is the Manitoba Museum of Man and Nature's way of giving everyone hands-on experience into a selection of important scientific and technical ideas. You will be able to feel, see, smell and experience science in ways that you've never dreamed possible.

Imagine a museum exhibit where you are encouraged to touch everything; where all of the displays are exciting and manipulative for both children and adults; where learning is so enjoyable and so much fun, it's painless.

Over sixty multidimensional exhibits will lead you on an exciting voyage of discovery and allow you to be your own master of the universe. Individual exhibits within the gallery offer a kaleidoscope of unusual experiences that help you TOUCH THE UNIVERSE. Step into an area where your shadow mysteriously stays behind on a phosphorescent screen after you have walked away. Stand in a room that appears to have no walls, ceiling or even a floor — a space that leaves you suspended in a myriad of images stretching off to infinity every way you look. Walk through a room of strange passageways and peculiar textures, where only the sense of touch will let you escape. You can converse with a talking computer or perhaps have a private conversation with a friend on the other side of the gallery by using the Sound Dishes. TOUCH THE UNIVERSE will challenge the limits of your senses when you view all sides of yourself at the same time; change faces with a friend or visit the “Ol’ Factory.” Even non-musicians are invited to pick up an instrument and make perfect harmony in the “Music Room.” Everyone will be able to participate in live science demonstrations that convey fundamentals of chemistry and physics with all the delight and wonder of a magic show.

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EXHIBIT: Pin Table

Your sense of touch comes alive as your hand comes in contact with the 165,000 pins of the pin table. This bed of pins allows you to create your own designs and wave forms by lightly sweeping your hand across the bottom of the pins.

Photo by Doug Smail

Continued on page 17
Should we do anything about astrology? Astronomy and astrology parted company sometime during the Renaissance. Astronomy has flourished, bringing our culture new understanding of matter and energy, glorious images of the universe, and revolutionary conceptions of cosmology. Astronomy has inspired many of mankind’s most creative minds, including Galileo, Newton, Maxwell, and Einstein. The practical benefits of astronomy range from celestial navigation to the discovery of helium (first seen in solar spectra), and the ability to track continental drift using radio interferometers and quasars.

Astrology is essentially unchanged from medieval times. What has it brought our culture? What thinkers has it inspired comparable to Galileo or Einstein? What practical benefits has it given society? Despite this extremely unflattering comparison, in the 1980s, astrology remains as viable and at least as lucrative a profession as astronomy. Nearly every newspaper in the United States runs a daily astrology column (how many newspapers run a daily astronomy column?). Publishers profit from hundreds of astrology books and magazines issued every year. The New York Times recently published a long, uncritical report about Wall Street businessmen who consult astrologers on what’s going to happen in the stock market.

Should the supporters of science take a stance on the popularity of pseudosciences such as astrology? Or is live-and-let-live a suitable response? The biologists ignored the pseudoscience of creationism for many years, and were taken by surprise when creationists successfully demanded space alongside evolutionary biology in school text books. Indeed, evolution (either the word or concept) has disappeared from the texts of many schools. The battle to restore the current science to biology texts has still not been won in all states.

Many astronomers believe there is a strong need to challenge the popularity of astrology. A vigorous debate in the astronomy profession took place over the efficacy of rational attacks on irrational beliefs. Eventually, a strong statement against astrology was published with the support of many leading astronomers. Mercury (the journal of the Astronomical Society of the Pacific) has produced excellent summaries of the discussion and bibliographies of the astronomers’ case against astrology.

Perhaps planetarium educators need to face this issue as well. Planetariums were created to communicate science to the public and to school children. We are in the front line for the advocacy and defense of our science. While research astronomers are not in the profession of informing the public, we are, and we have a broad and continuing forum to do so.

Nevertheless, there are arguments against our taking action. Before we can argue with pseudoscience, we need to understand a great deal about it. We would have to be willing to take the time to study astrology, to learn what it says, and to examine the hard evidence that has been gathered about it. Perhaps an attack would backfire, dignifying astrology by granting it time in our planetariums. Effort we spend on astrology would have to be at the expense of some topic in real science we might have treated instead. And we don’t know whether we will really convince any supporters of astrology that they might be wrong.

What are your feelings on this issue? I think IPS, through its journal and through its meetings, would be a lively and appropriate forum for tackling the matter. I’d very much like to hear from you on whether or not we should pursue the challenge of astrology. □

TOUCH THE UNIVERSE

. . . continued from page 16

TOUCH THE UNIVERSE is an interactive and experimental science gallery surrounding the Manitoba Planetarium’s Star Theatre on the lower concourse of the Manitoba Museum of Man and Nature. When the Museum and Planetarium set out to build a new exhibit in this space, they wanted it to be the best — to convey a real understanding of science in the most exciting and memorable way. The first phase of planning involved visits to the greatest science centers and museums in North America and Europe. Some of the most interesting exhibits from the Ontario Science Centre, the Exploratorium in San Francisco and the Franklin Institute in Philadelphia were selected for inclusion in TOUCH THE UNIVERSE. A good measure of invention was added by the Manitoba Planetarium’s staff, completely redesigning those established exhibits to suit the TOUCH THE UNIVERSE theme, and creating whole new exhibits.

TOUCH THE UNIVERSE is smaller than the vast science centers of the great metropolitan areas. It compensates by incorporating outstanding levels of excellence and craftsmanship in each and every exhibit. Artists, designers, scientists and educators have utilized many forms of common material with top-of-the-line electronics to produce a sensory delight. You’ll be dazzled! □
Great Plains Planetarium Association (GPPA) and Rocky Mountain Planetarium Association (RMPA) will hold a joint conference on October 16, 17, and 18 at the McDonnell Star Theater in St. Louis, Missouri. Laura Kyro of McDonnell is conference chairperson. Emphasis of the conference is on small-facility activities. Tentative plans include an audio workshop, a projector and electronics hands-on session, and slide generation.

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Pacific Planetarium Association (PPA) — The next meeting will be October 10–12, 1986, at the Chemeketa Community College Planetarium in Salem, Ore. Thomas McDonough is the host.

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Rocky Mountain Planetarium Association (RMPA) — RMPA has noted with concern the closing of a school planetarium in their region: Boulder Valley Schools Planetarium, directed by Jim Moravec. The planetarium had an excellent educational record but was closed by its school district as a budget-cutting measure.

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Southeastern Planetarium Association (SEPA) — SEPA meets June 22–26 at the Morehead Planetarium of the University of North Carolina in Chapel Hill. Host Jim Manning and his staff have many interesting activities planned at press time. The theme of the conference is “Perceptions,” referring both to the crafts, techniques, and technologies that characterize modern planetariums and to the perceptions of planetariums by people from both outside and inside the field.

Conferees will visit two different types of planetariums: Morehead with its Zeiss VI and traditional environment, and the Zane Planetarium at the Greensboro Science Center with its Spitz 512, tilted dome, and unidirectional seating.

In addition to papers, workshops, and panel discussions, the conference includes a visit to the Three-College Observatory with its 32-inch reflector, one of the largest telescopes in the Southeast. Guest speaker at the banquet is Dr. Doris Betts, Alumni Distinguished Professor of English at UNC and a highly respected author and educator.

Southwestern Association of Planetariums (SWAP) — The April meeting of SWAP in the Davis Mountains of West Texas was organized by Barbara Baber, now president-elect. Other new officers are: president, Bob Kelly; past president, Keith Goering; secretary-treasurer, K. H. Johnson; newsletter editor, Jim Rusk; board members, Wynn Godwin and Wayne Wyrick; and IPS representative, John Pogue.

Conferees noted transitions in the careers of two of their number. H. Rich Calvird, director of the El Paso Public Schools Planetarium, has retired after a long and successful career to a farm near Jacksonville, Texas. SWAP’s award for outstanding service is the H. Rich Calvird Award, and Rich was the first person to receive it. Replacing Calvird in El Paso is John Peterson, formerly director of the Clyde Tombaugh Space Theater in Alamogordo, New Mexico.

Mark Wallace, director of the planetarium in Andrews, Texas for 10 years, is now assistant principal at Andrews Middle School. He was presented with a plaque for his contributions to SWAP. Lana Woodcock has taken his place at the planetarium.

During the business meeting, members discussed the possibility of incorporating as a non-profit organization.

South Carolina State College in Orangeburg has an immediate opening for director of the Stanback Museum’s Planetarium. The 12.2 meter facility features a (Viewlex) Minolta Series II-B and a seating capacity of 100. Candidates are required to have previous planetarium experience and a bachelor’s degree; a master’s degree in the physical sciences, science education or a related field is preferred.

Salary for the position, which is under a 12-month contract, is “commensurate with background and experience.” For more information, call Dr. Leo Twiggs or Don Walter at 803-536-7174. To apply, send resume and phone numbers of three references to: Don Walter, Planetarium Director / South Carolina State College / Orangeburg, South Carolina 29117 / USA.
In this issue, I'd like to review several software packages that were produced specifically for use in schools. Although they are not immediately applicable to the planetarium, their purpose is to teach an understanding of the sky, and that's a goal we all share.

First, I'd like to mention, in passing, two companies whose software is disappointing.

Hubbard Scientific (P.O. Box 104, Northbrook, IL 60062) offers three separate programs for school use, all for Apple IIs. The first, Astronomy Data Bytes, is a collection of facts about astronomy with super-simple diagrams. It could be replaced by a small pamphlet with no loss; there are no computations. The second, Stellar 28 Constellation Games, puts barely recognizable constellation outlines on the screen and asks you to identify them; to make it exciting you can choose to respond with the Latin or English name. Again, there are no computations. You score by guessing correctly. The third, Computer Star Finder, generates a planisphere-type display of the sky for a given location and time, with several dozen stars shown at once. Some constellations are recognizable. The planets are plotted, and their celestial coordinates can be displayed. This program is sold with Hubbard's Luminous Star Finder, which may be worth more than the software it accompanies.

The second is Cross Educational Software (1802 North Trenton St., P.O. Box 1536, Ruston, LA 71270). They offer two astronomy packages for Apple IIs or IBM-PC. The programs are only a series of crude diagrams with even cruder text. Although some diagrams are animated after a fashion, only someone who has never seen a computer display will be impressed. Only inconsequential computations are performed, and a short stack of 3 x 5 cards would be more useful (and quicker to use). They are also packed to capacity with silly errors. I offered to correct the most glaring for no charge if they would send me the text of the disks, but they did not respond. So as far as I know, they have still never been reviewed by an astronomer.

The Daily Planet (School Management Arts, Inc., P.O. Box 1, Boston, MA 02195, for any Apple II with 64k memory or IBM-PC with 64k memory) is divided (somewhat artificially) into 16 lessons plus a freebie on Halley's Comet. The actual program and the computations it performs are relatively simple, and since more complex software is in public domain, it will not appeal to the typical amateur astronomer. The Daily Planet calculates each planet's position, magnitude, phase, etc., and plots it on the simplest of star maps. If there were nothing more, its value would be minimal. The strength of the software package, however, is that it comes with a detailed and well thought-out lesson plan that should appeal to many teachers. The plan links the lessons in a way that makes them seem to follow each other naturally so that each builds upon the preceding. It uses the cookbook approach, and reminds me of college chemistry labs, but teachers who appreciate step-by-step instructions and who are not terribly familiar with the material will find something useful here. Each lesson ends with questions for the student, and the answers appear in an appendix.

Sky Lab (Minnesota Educational Computing Corp., 3490 Lexington Avenue North, St. Paul, MN 55126, for any Apple II with 64k memory) is the most ambitious of the classroom software reviewed here. It is targeted for ages 6–8. The goal is to teach a limited number of fundamental concepts, but to teach them well, and it succeeds. The concepts are the daily rotation of the earth, the revolution of the earth around the sun, and the movements of the planets as seen from the earth or sun. A fourth program illustrates the motions of Halley's Comet. The student is presented with either a backyard or space view, and switches between them to see how, for example, the constellations appear at different times of the night and different months of the year. The graphics are the essence of simplicity and clarity, the text is brief and to the point, but most importantly, the goals are clear and well thought-out. The thick manual helps put it all together and is an invaluable addition, although the lessons as presented on disk are self-explanatory. The manual also describes many supplemental classroom activities to support the lessons learned on disk. I'm impressed with the way that Sky Lab treats a select number of topics thoroughly and accomplishes its goals, rather than uses a shotgun approach toward astronomy in general. One minor complaint: there are 13 constellations in the astronomical zodiac, not the 12 of the astrological zodiac as presented in the program.
AN UPDATE ON RESEARCH INTO THE EFFECT OF TEACHING METHOD AND SPATIAL VISUALIZATION ABILITY ON PLANETARIUM EDUCATION

A paper presented at the annual meeting of the National Association for Research in Science Teaching held in Dallas, Texas during April, 1983 may have applications for planetarium educators. Charles F. Porter and Russell E. Yeany from the University of Georgia reported their research findings ("The Effects of Using Two- and Three-Dimensional Models on Science Achievement of Students with Varying Levels of Spatial Ability, Cognitive Development, and Gender").

The rationale for their study originated in the research evidence that indicates that formal ideas should be taught with concrete props which model the abstract concepts.

For the purposes of their study, they defined a two-dimensional model as a diagram and a three-dimensional model as a replica.

Their experimental population consisted of five classes (n = 130) of tenth grade biology students. Two of the classes were college preparatory and three were general classes. The student population represented a large cross section of socio-economic, racial, and ability levels.

Each class received each of the treatments (2-D, 3-D, and 2-D + 3-D) once, with the sequence of treatments randomly assigned to the classes. The topics taught were homeostasis, DNA/protein synthesis, and mitosis/meiosis. Pretests were given to determine cognitive development and spatial visualization ability. Posttests were given after each unit was taught and at the end of the experiment.

The data were analyzed using a 3 x 3 x 2 x 2 (three treatments x three levels of cognitive development x two levels of spatial visualization x gender) with analysis of variance. Figure 1 illustrates this four-factor design.

Here is a summary of the main effects found in the study. Six of the seven significant differences favored a combination of two- and three-dimensional instruction. Two-dimensional instruction was most effective only once.

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**FIGURE 1**

A 3 x 3 x 2 x 2 factorial design to study the effects of instructional strategy, level of cognitive development, spatial visualization ability, and gender on the achievement of high school biology students.

**INSTRUCTIONAL STRATEGY**

Level of Cognitive Development
- F = formal
- T = transitional
- C = concrete

Instructional Strategy
- 2 = two-dimensional
- 3 = three-dimensional
- 2 + 3 = two- + three-dimensional

Spatial Visualization Ability
- Hi = high spatial ability
- Lo = low spatial ability

Gender
- M = Males
- F = Females
When comparisons were made for the relationship of cognitive development and achievement, all twelve significant differences favored the formal operational students. Only two comparisons in the study favored students of high spatial visualization ability significantly. Females were also shown to have significantly outscored males on eight comparisons.

Based on these results, Porter and Yeany conclude that biology teachers should incorporate both two- and three-dimensional models in their teaching. They also suggest that, "This strategy should also help students to better understand the subject matter regardless of their level of cognitive development, spatial visualization ability, or gender, although teachers can generally expect formal operational students to outperform non-formal students and female students to outperform males."

What, if any, conclusions can planetarians draw from the results of this experiment? Of course, any generalizations applied to planetarium education are done with caution for obvious reasons, but some comparisons can still be made.

The teaching strategies used in this study (2-D, 3-D, and 2-D + 3-D) may be thought of as comparable to classroom (blackboard, book, etc.), planetarium, and combination of classroom and planetarium. Remember that the authors of this study defined three-dimensional models as "replicas", and of course that is exactly what the planetarium is.

Having redefined the teaching methods in terms of the planetarium, we can now interpret these findings as possibly applying to planetarium education. If we do so, we see that the combination teaching method is favored six times. Now, if we look at subgroups of students, we see that half of these significant differences occur with the general group. In other words, those students with lower math and science aptitudes may favor the combination (planetarium and classroom) instruction.

Grouping by subject matter, we find that five of the six significant differences occurred in only one subject (DNA/Protein Synthesis). This raises the possibility that this subject matter is better suited for the combination instruction. That conclusion could also reasonably be applied to planetarium instruction.

If our generalizations of this study to planetarium education are accurate, we would urge teachers to use a combination of classroom and planetarium instruction. But we may be missing important information about how this teaching method might vary across other student characteristics. A future column may look more closely at these potential interactions.

### Compact Disk Players

By the end of 1986, about two million compact disk players will have been sold in the United States. The sudden acceptance of this new technology has many people in the recording industry worried. Not since the early 1950's, when the 78-rpm record was phased out in favor of the 45-rpm single and the 12-inch LP, has such a fuss been made. While consumers are busily purchasing compact disk players and compact disks (CDs), the recording industry is keeping a fair distance from the new format. Only six thousand titles are presently available on CD, and most of these are old analog recordings that have been digitally remastered. Even some of these oldies begin to shine on CD. When they are digitally remastered, much of the tape hiss, which is so prevalent on older recordings, is lost.

The difference between an analog and digital recording is how the music is stored on each. Music is recorded in grooves on a record. In these grooves, the music is in the form of hills and valleys which your turntable's stylus rides over and reproduces. One of the problems with this system is that the grooves contain other things besides music. They contain dust, grease, and other imperfections. They also do not contain the full dynamic range possible in a recording studio.

While a record contains a portrait of the music which is subject to distortion and deterioration, a digital recording does not contain any music at all. Instead, a CD contains a numerical representation of each instant of sound. When this digital information is decoded, the resulting electrical output contains precisely what the input contained. There is no hiss, no wow, no flutter; just music.

Even with these refinements in the recording process, there are a few things to look for when purchasing a CD player.

1. As with all audio equipment, compare the specs. Although most mid-line players have about the same specs, some differences are apparent in both sound quality and features. Also, you may want to check independently measured specifications.
INTRODUCTION

The following lesson has been used with eighth grade students involved in the gifted program in the Methacton School District. The gifted program for the Arcola Intermediate School (grades 6, 7 & 8) utilizes a Humanities curriculum which in grade 8 explores the theme, “Achieving: From the Cave to the Computer.” In this course, students examine the great technological advances of the past and their effects on humanity’s perception of itself, our world and our future. Students attempt to evaluate the positive and negative uses of technology and its effects on civilization as well as possible technological advances for the future.

This exploration of technology begins with an analysis of some of the major advances of the Renaissance, such as the telescope, the printing press, the compass, gun-powder, and optics. The planetarium lesson described here correlates with this curriculum by offering the students an overview of some of the major astronomical ideas held prior to the Renaissance and how the technology of the telescope changed them. By examining this time period and in particular, the work of Galileo, students come to realize that the changes which occurred in attitude and perception about the universe did not happen overnight, but took many years and much hard work to accomplish, and in some aspects continue to this day.

Although there are many excellent books that could serve as resources for a lesson on this topic, I would heartily recommend that the reader examine “Horizons, Exploring the Universe” by Michael A. Seeds. In this book, Seeds includes an Historical Supplement entitled, “The 99 Years that Changed Astronomy.” This chapter offers a thoughtful summary of the astronomical changes in the Renaissance period. The basis for the chapter title is explained as follows:

The story of modern astronomy begins with the death of the great Polish astronomer Nicolaus Copernicus in May 1543 and the almost simultaneous publication of his theory of the universe. That theory revolutionized not only astronomy, but all science, and inspired a new consideration of our place in nature. We will trace this story over the 99 years from 1543 and Copernicus’ death to 1642 and the death of another great astronomer, Galileo, and the birth of one of the greatest scientists in history, Isaac Newton. . . . We date the origin of modern astronomy from the 99 years between the deaths of Copernicus and Galileo because it was an age of transition. That period marked the transition between the Ptolemaic theory and the Copernican, but it also marked a transition in the nature of astronomy in particular and science in general. Before the events of our story, scientific principles were drawn not from observation but from philosophical judgments of what the universe should be like. (Seeds, 1981)

It is hoped that this planetarium program will be useful to other directors working with students in an examination of the events of the Renaissance. Regardless of whether the lesson is presented only to students involved in a gifted program, or to general students studying this time period as part of Social Studies, the insights gathered by looking at how humanity’s perception of our universe and ourselves changed, will be a valuable lesson for all.

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 Presentation. The sharing of ideas will be greatly appreciated by your colleagues in the field! Please share. Thank you.
PURPOSE:
To explore the time of the Renaissance and the importance and problems of the telescope in that period.

BEHAVIORAL OBJECTIVES:
By the end of the lesson, the student will be able to:
1. List some of the concepts that people in pre-Renaissance Europe had for parts of the universe.
2. List some of the advantages and disadvantages of Earth-based telescopes.
3. Explain the importance and problems of using a telescope to show people of the Renaissance information about the universe.

MATERIALS:
Worksheets, slides (describing some of the concepts held prior to and during the Copernican Revolution), slide projector with attachment to simulate the effects of our atmosphere on telescopic viewing of the moon (a rotating, rippled sheet of plastic placed in front of it).

PREPARATION:
- Planetarium should be set for current date, set for latitude of Pisa, Italy (44° N), and for noon.
- Align projectors for telescope drawing activity.
- Set up slides and projectors.
- Prepare worksheets and overhead transparencies.

PRESENTATION:
Greet students and explain purpose of lesson. Introduce topic.

Part 1 — The Geocentric Universe
Using slides and the planetarium projector, present the view of the universe and of humanity held prior to the Renaissance. (An effective and enjoyable method of presentation involves teaching the lesson as though the students were attending a “European University” at the time of the Renaissance and were reviewing a description of the known universe with their “professor.” The planetarium helps to demonstrate the concepts as they are discussed . . . “the sun revolves around the earth” [daily motion is demonstrated]. Students could attempt to answer questions as they think they would be known at that time [example: How many planets are there in the universe? Student response: There are 5 planets; Mercury, Venus, Mars, Jupiter, and Saturn.] If students give information that was unknown at the time, they can be “reprimanded” for blaspheming the true nature of the universe.) In this presentation, stress the logic of the geocentric universe (“After all, it does look as if the sun is moving around us”). Students should complete their worksheet listing some of the impressions held for: the Earth, the Planets, the Sun, the Moon, the Stars, and the Telescope.

Heaven and Earth
To the people of pre-Renaissance Europe, the universe was quite a different sort of place than we conceive of it truly. To them, the universe was divided into two parts — the earth, corrupt and changeable, and the heavens, perfect and immutable. To understand the importance and problems of using the telescope to change people’s notion of the universe, list some of the impressions they held for the following: example, what were they considered to be, where were they, etc.)

THE EARTH

THE PLANETS

THE SUN

THE MOON

THE STARS

THE TELESCOPE

The Telescope
The invention of the Telescope opened entirely new worlds to people to discover and explore. It forever changed people’s view of the universe and of themselves. The Moon was not a “polished perfect sphere” as was taught and the heavens were not perfect and immutable. As great as the telescope is, however, it cannot overcome an obstacle of the earth’s composition — its atmosphere. As long as telescopes are earthbound, they must contend with the problems of seeing through an “ocean of air.” For this reason, the Hubble Space Telescope has been developed. When it is placed into orbit, it will once again open new worlds to us.

To experience what it is like to study astronomy through an earth-based telescope, try an activity which was first conducted in real life by Galileo. You will see the moon projected on the dome, attempt to draw as much of the moon as you can in the space below. You will note, however, that the atmosphere will be changing. During the moments when the atmosphere is clear and stable, try to draw as many features as you can. Just like Galileo, you will see the moon magnified by 32 times (but unlike Galileo, you will have the advantage of being able to see the whole moon). The telescope that Galileo used only allowed him to see about one quarter of the moon’s diameter. To find out more about this problem, and telescope types, check the study sheet “It Began in 1608” after you finish this activity.
Part II — The Age of Transition

Present the new view of the universe as set forth by Copernicus. Stress the impact which this would have had on Europe at that time. Then, the Church was more than just a religious institution; it was a governing body with great powers over everyone. The Church taught that the Earth was the CENTER of the universe and of God’s attention. The Church was being confronted by Martin Luther at this time and did not want further confrontation. To teach in defiance of the Church was heresy and punishable by death. Galileo heard of the invention of the telescope and decided to use it to study the sky. His telescopes were not very powerful. They magnified from 9 to 32 times but were designed with a very small field of view. His most powerful would only show about one-quarter the diameter of the moon. (Brown, 1985) Yet Galileo was able to gather evidence that was quite damaging to the accepted view of the universe. Obviously, either Galileo had to be mistaken or was working with the devil to bewitch his telescope.

Part III — Earth-Based Telescopes

Since the time of Galileo, people have studied the universe using telescopes, but these have been on Earth, and as such, have had to deal with the problem of the Earth’s atmosphere. To understand the problems of this, students will attempt to draw a sketch of the moon — similar to the work Galileo did — and will do it under similar conditions with a changing, unsteady atmosphere. (Use special projector with rotating wheel to simulate atmospheric change.) Students should be given some time to work and then the drawings can be briefly examined for similarities and mistakes that may have occurred. (This activity is an adaptation of the “Fuzzy Mars” observing activity developed by Sheldon Schaefer of the Lakeview Center Planetarium and used in the program “The Red Planet Mars.” (Friedman, et. al., 1980)

CONCLUSION

Review the major concepts presented in the lesson (concepts held prior to Renaissance, Copernican view, Galileo’s work, problems with earth-based telescopes) and then ask the students how the problem of the telescope could be addressed with today’s technology? The students will probably respond that objects could be studied from space. Use this opportunity to describe the Hubble Space Telescope which will be placed into orbit around the earth and thus will allow us to study the universe without the effects of the earth’s atmosphere distorting the images. Leave the students with the thought that this device may yield information about the nature of the cosmos which may force us the change our current perceptions just as Galileo’s telescope did for his contemporaries.

BIBLIOGRAPHY


SKY Notes . . . continued from page 21

2. Check for vibration problems and shock immunity. As with your turntable, the disk player can only handle so much vibration before the laser begins to skip. Do not be afraid to crank up the amplifier volume and listen for minute error correction problems resulting from the disk vibrating. Then, when the salesperson isn’t looking, whomp the player a few times on the top and sides and see how much force it takes to make the player skip. (Editor’s Note — do so at your own risk!)

3. You may want to purchase a disk and scratch it, and then audition it in the players you are looking at. Listen for the player’s ability to correct the errors. Every player will hiccup when it encounters a major error; judge how much is acceptable to you.

4. Decide if you want a one-beam or three-beam player. To correct skipping, many manufacturers have released mid- and top-of-the-line players with three laser beams. While one, and possibly two of the lasers may skip a track, the third one will probably get it; or so the theory goes. One small, and I do mean small, problem with this system is beam alignment. Unfortunately, just like with slide projectors, three laser beams cannot be exactly aligned. Since the dot of light striking the surface of the disk in a three-beam system is slightly larger than in a single beam player, the music is slightly muffled.

5. After listening to all the sales people, and reading all the literature, choose one that has the sound and features you want. You’re the one that has to live with the CD player, so make sure you buy the one you want, not the one the salesperson wants you to buy.
Those of you who sell astronomical materials in bookstores or giftshops will be interested in this. AstroMedia presents a beautiful, informative poster of the Voyager 2 flyby of Uranus. This color poster measures 21" x 30" and presents eight scenes of Uranus, its rings, and its mysterious moons. To order (minimum order of five is required), contact AstroMedia at 800-558-1544.

To those of you who enjoy videotapes, we have come across one from Moor Enterprises entitled, "Let’s Go To The Planetarium." It runs for 21 minutes and gives a history of planetaria, along with covering space phenomena, and a tour of the Solar System. It is available in either Beta or VHS format. Interested parties should contact Mr. Charles Moor, 863 Bingham St., Thatcher, Arizona 85552.

The Astronomical Society of the Pacific announces a useful new resource book for teachers of astronomy at the university, college or high-school level. Entitled The Universe at Your Fingertips, it was written by astronomers/educators R. Robert Robbins and Andrew Fraknoi. It is 96 pages long and organizes a “wealth of materials available to help teachers of astronomy.” For further information on this $8.95 book, contact ASP, IAU Book Department, 1290 24th Ave., San Francisco, CA 94122.

Astro-Dome® and Astro-Dots are two astronomy books published by Sunstone. These have been very popular with teachers and planetarium shops across the country. While Astro-Dome® is a mini-planetarium that is assembled by the buyer, Astro-Dots is a “Connect the Stars” workbook. Astro-Dome® sells for $8.95 and Astro-Dots sells for $3.95. For additional information, contact Sunstone, R.D. #3, Box 100A, Cooperstown, NY 13326.

Job duties will include: production of artwork for Hansen Planetarium star shows and other special events; design and production of posters, brochures, displays, newsletters, etc.; using the Digistar PS 330 Graphics Processor to digitize artwork; active participation in other aspects of show production; design and production of advertising and saleable items for HP Publications. Knowledge of art/graphics methods, tools and media as well as research skills is essential. Knowledge of photography, typography, production and printing techniques is desirable.

Planetarians are hereby notified of the upcoming International Astronomical Union Symposium No. 124 on Observational Cosmology that will be held on August 25-29, 1986 in Beijing, China. Co-sponsored by the China Association for Science and Technology, this English-language symposium is chaired by Professor Geoffrey Burbidge of the Center for Astrophysics and Space Science, University of California in San Diego.

Two post-symposium tours to the major scientific and cultural centers of China are also offered. Registration is 150 U.S. dollars; $80 accompanying person; $60 student. All travel arrangements are being made by Pacific Delight Tours, Inc., 132 Madison Avenue, New York, NY 10016 USA. Contact Marie A. Zuniga at (212) 684-7707 for further information.

The Yokohama Science Center in Japan has now set up a computer bulletin board for the rapid exchange of astronomical information. Look for “The Space Board;” system number (045) 832-1177, transmitting at 300 BPS. Have your machine ready for 8 word bits, 1 stop bit, no parity. The system operates 24 hours a day, except for occasional maintenance. For further information, contact:

Astronomy Section
Yokohama Science Center
5-2-1 Yokodai Isogo-ku
Yokohama 235 JAPAN
(045) 832-1166

Job OPPORTUNITY FOR GRAPHIC ARTIST

The Hansen Planetarium, a division of Salt Lake County, expects to have an opening for a full-time artist. For more information, contact Brad Greenwood, lead artist, c/o Hansen Planetarium, 15 South State Street, Salt Lake City, Utah, 84111 — (801) 538-2104.
I thought I knew my answer. Then, why does it keep changing every day? I still want to go (I think). Nothing could make me not want to participate. But something did. As reported in a previous column, I was one of 10,000 or so who applied to be the first teacher in space. I wasn’t accepted. That was a long time ago, months ago. But then it happened. I was back in the news again. They wanted to know what I thought.

“Yes, I wanted to go on the shuttle. Yes, even after the tragedy, I still do. How can one not want to participate in the grandest adventure of our age?” That’s what I told them.

Them: the macabre TV reporters who called moments after the shuttle explosion and asked “How do you feel about the astronauts being killed?” Them: all my loved ones who called that evening long distance to say how glad they were that I wasn’t selected; to say that it was like the day Kennedy died and they somehow again felt disbelief and personal loss.

And most especially them: the students, young people who were suddenly re-thinking space career dreams. They were not blase as the reputation of their adolescence often purports, but truly affected by the event, needing to talk about it, as I did. I started it. I told how I felt: devastated, sad. “Would anyone like to say anything?”, I asked. Tentatively, someone spoke up, softly. I listened. Then another seemed brave enough to say his true feelings. I forgot what the lesson was supposed to be as more students volunteered to speak. No one seemed to express the loss in the same way as another; by talking about it, we ‘got through’ this far-away tragedy that seemed all too personal.

A small voice inside me tells me that I still want to go. The point is not whether I will be invited to participate (I would say there is a very slim chance of that!), but do I want to go? As if wanting to go was the same as being there. Maybe it is . . .

OVERHEARD:

Bing Quock, of Morrison Planetarium, found an entry in the local San Francisco TV Guide for “JACK HORKHEIMER: STAR HUSTLER — Astrology.”

Don McDonald, of Eureka, California, discloses that the real reason Minolta chose California for its first planetarium was that it’s closest to the factory!

Gary Tomlinson of Grand Rapids, Michigan’s Roger B. Chaffee Planetarium relates that fellow planetarian Dave Hoffman of Muskegon (Michigan) Community College had everyone going at a recent GLPA meeting. Dave said, “We did a program on sleep at our planetarium and one of the most unusual and interesting effects was chosen for a panorama system. We took this very neatly made bed and placed a camera in the center. We then took a photograph every 30 degrees and created the best-looking bed pan you ever saw!”

Gary encouraged students visiting his planetarium to share Comet Halley viewing with someone who saw it in 1910, or at least to get them to talk about it. One 4th grade student was heard to ask his 25-year-old teacher, “What did Halley’s Comet look like back then?”

Jon Bell, of Peninsula Planetarium in Newport News, Virginia justifies charging a fee for looking at Comet Halley through the Center’s telescope this way: “If they see it for free, they feel like they’re not getting anything!”

Write to the vendors for prices and ordering information.

These programs are biased toward Apple II Computers because Apples dominate the school market. There are many more astronomy programs than these for classroom use in circulation, but I’ve limited myself to these few because this is a column, not a feature. If there is interest, I’ll review others in a later issue.