SOUTHERN SKIES

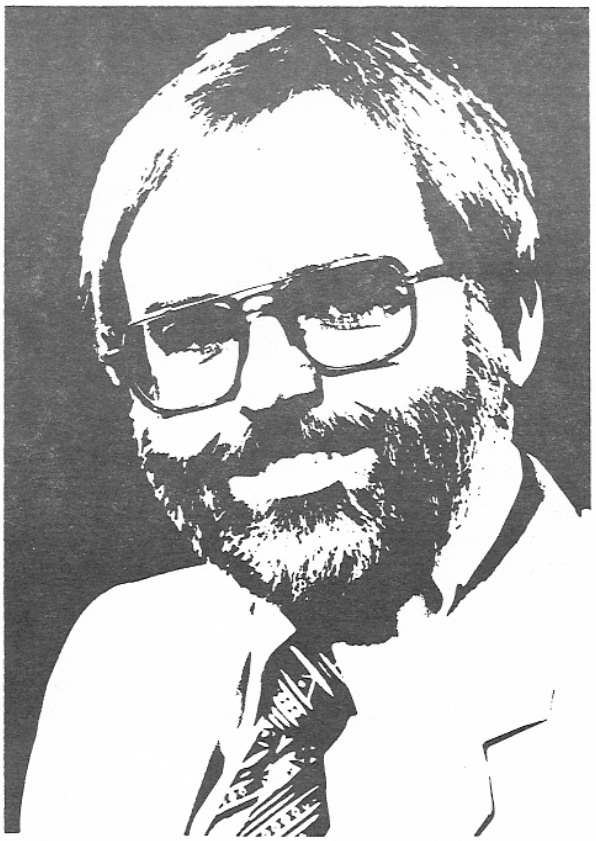
Newsletter of the Southeastern Planetarium Association

Southern skies

SOUTHEASTERN PLANETARIUM ASSOCIATION

A Message From Your President

by Duncan Teague



Now that the SEPA Conference is over I am sure you all will agree it was really great. The Universe is a first class planetarium that we would all like to visit again. We especially owe a big thank you to Charlie Smith who did a super job of pulling off the hosting of SEPA, the IPS Council, the Major Planetarium Executives Group, and the American Planetarium Association all at one time!!!

I am now permitted to announce, Craigmont Planetarium is producing its third program for NASA. It is entitled "The Pioneers of Space" and focuses on Pioneer 10's exit from the solar system. October 1, 1983 will be NASA's 25th anniversary, and December, 1983 is the 10th anniversary of Pioneer 10's fly-by of Jupiter. A number of planetariums will receive the program as a door prize at the conference. Several other packages will be produced for distribution on free loan. Each package will include a script, a soundtrack including a "weather report" from the edge of the solar system (with electronic music by Mark Petersen), and a ten-minute 16mm film in three segments.

One of my duties as SEPA representative to IPS is to summarize IPS activities. You can find out how good a job I'm doing by requesting the Council Bulletin from IPS President Jeanne E. Bishop. Any IPS member is welcome to receive it. Contact Jeanne at 1721 Canterbury Road, Westlake, Ohio 44145. Jeanne gets the urge to communicate every couple of months.

IPS is engaged in several projects which may be of interest to you. One involves the writing of articles for journals your superordinates are likely to receive. The gist of these articles would be "How wonderful it is to have a planetarium!" Another involves NASA support for

the production of a 28-1/2 minute video tape to say and to show "How wonderful it is to have a planetarium!" Still another is a video disc of space topics to say and show--with random access--"How wonderful it is to have a National Aeronautics and Space Administration."

Dr. Kurt Firness, Berliner Strasse 60, 6380 Bad Homburg, West Germany wants to know of training programs for planetarium directors for a person who will be Director of the Riyadh Planetarium in Saudi Arabia. Please write him if you know of a program.

My March proposal encouraging SEPA members to contribute a star show for distribution on free loan to other SEPA members received one positive response. Mike Ryan has offered his star show "Billy's Space Dream." This program is a most entertaining fall constellation show. It involves the Andromeda legend as told by Astrobird to Billy in his dream about "stars and monsters." Let me know if you are interested in borrowing "Billy."

Jim McMurtray's show "Starlight" has now been distributed to seven planetariums, and one more is scheduled to receive it in August. If you've borrowed "Starlight," I'd like to pass on your comments to the author. Please share them with me.

Speaking of Jim, you recall he works at the National Space Technology Laboratory in Bay St. Louis, Mississippi. I had the good fortune to visit Jim at NSTL last summer. My family and I were treated to a VIP tour of the facility including space shuttle "Challenger's" engines. One was still crated; one, uncrated but still wrapped in plastic; and one, inside the "clean" room. No, I'm not responsible for the fuel leak on the one I touched.

Our visit was timed to coincide with a test firing of one of the experimental shuttle engines. The engineers were going to "hot rod" the engine up to 115% of its designed thrust. If you've seen a shuttle launch you know how loud it is even from 3.5 miles away. Well, we were to observe this test firing from only 1,200 feet away!

Water was being sprayed across the test stand at a rate of 100,000 gallons per minute to keep the metal stand from melting. Jim told us it would be loud and that it would rain when steam from the exhaust cooled and condensed. And he said this with a very straight face. I should have known something was left unsaid when he encouraged us to observe from the roof of a building while he waited inside.

Well, it was indeed LOUD. Blood vessels in my eyes burst. My chest hurt for two days. It RAINED six inches in 500 seconds. If you would like to be scared to death some time, by all means visit NSTL. It's about an hour east of New Orleans off Interstate 10.

I think I am going to go rest for a while!

WANTED

PLANETARIUM SPECIALIST

The Bishop Planetarium has an immediate opening for a qualified planetarium professional. Minimum requirements are a B.S. or B.A. with an overall knowledge of astronomy. Planetarium show production experience is essential. Limited knowledge of optics, electronics, photography and public relations is also required.

Job responsibilities are demanding with some weekend and evening work necessary. Primary responsibility is to function as Staff Astronomer and Education Coordinator. This area includes developing and presenting programs for school groups, organizing and teaching adult evening classes, and coordinating production and distribution of astronomy information to the media. Other duties include assisting in production and presentation of public starshows, production and presentation of laser shows, occasional

operation of observatory for public viewing sessions, and other "general" planetarium tasks. WHEW!

Salary $14,000+ depending upon experience and qualifications.

If you are crazy enough to want to subject yourself to the above abuse, but reap the many intangible rewards offered by this profession then contact:

John Hare, Director
Bishop Planetarium
201 10th Street West
Bradenton, Florida 33505

Phone: (813) 746-4132

Morehead Planetarium
University of North Carolina
Chapel Hill, North Carolina

by Jim Manning

In the 1940s John Motley Morehead, distinguished alumnus of the University of North Carolina, wished to give a gift of lasting value to his alma mater to benefit the citizens of his native state. His interest in astronomy suggested either an observatory or a planetarium. Mr. Morehead consulted the eminent astronomer Harlow Shapley, who advised that a planetarium be given, stating that North Carolinians were "the most astronomically ignorant people in all America." Mr. Morehead replied that if Shapley would amend his statement to: "Of all the people in America, North Carolinians are the most ignorant of astronomical matters," a planetarium would be built. Shapley did, and the Morehead Planetarium was conceived.

The Morehead Planetarium opened on May 10th, 1949, on the campus of the University of North Carolina in Chapel Hill. It was the sixt planetarium built in the United States, the first in other than a major city, and the first located on a college campus. Its original planetarium instrument was a Zeiss III, brought by Mr. Morehead from Sweden to be placed under a 68-foot diameter stainless steel dome and surrounded by 450 seats in concentric rows. Dr. Roy K. Marshall directed its operations for the first year and a half; he was then succeeded by Anthony Jenzano, who remained at the helm until his retirement in 1981. Dr. Lee Shapiro is the current director.

Since its opening 34 years ago, the Morehead Planetarium has welcomed more then 3,000,000 visitors, drawing 100,000 people annually to its programs and exhibits, half of them school children. The Planetarium offers a variety of live and taped public programs each year, ranging from the weekly "Sky Rambles," a live-narrated tour of the current night sky, to the original science fiction production "Juggernaut," featuring the voice of William Shatner of "Star Trek" fame. In addition, seven "school" programs geared for specific age groups from pre-school through college are offered on weekdays through the acadmic year.

Supplementing the star theatre presentations are numerous special and cultural programs and activities, including courses and workshops, laser light shows, live poetry readings under the stars, programs of live music, and demonstrations for special groups. Astronomy and science exhibits include a 35-foot walk-in Copernican Orrery: a model of the solar system showing the six

inner planets in proper relative motion about the sun, one of the only working models of its kind in the world. Periodically displayed are astronomical instruments brought from Europe to the university in 1824 by its first president, for use in what is reputed to have been the first university observatory in America.

The planetarium is also used as a laboratory for university astronomy and navigation classes, and has served as a site for NASA experiments in barium cloud analysis and studies in the orientation of birds to star patterns.

Morehead played a unique role in the U.S. space program from 1960 through 1975 as a NASA training center, developing and administering training in star recognition to the astronauts of the Mercury, Gemini, Apollo, Skylab and Apollo-Soyuz programs. Primary and back-up crews were placed in Mercury, Gemini, and Apollo capsule simulators in the star theater and were drilled in the techniques of celestial orientation, recognition of stars and constellations, and situations related to specific missions. This training enabled the astronauts to provide visual data to on-board navigation computers during their missions by looking out their capsule windows and getting fixes on the star fields they saw.

The Morehead Planetarium building houses a variety of facilities in addition to the star theater, exhibit halls, and planetarium offices and work areas. These include art galleries, dining halls, lounges, and meeting rooms used for a wide range of university-related functions. In the building's east wing reside the offices of the Morehead Foundation, which administers the Morehead Scholarship and Fellowship programs, and which in 1973 established the Morehead Internship in Planetarium Administration and Education, providing support for graduate work and planetarium training for future planetarium professionals.

Capping the east wing is the Morehead Observatory, also established in 1973 and directed by the Department of Physics and Astronomy of UNC. The decorative copper dome houses a 24-inch Boller and Chivens Cassegrain reflector with auxiliary four- and six-inch refractors, all used for teaching, research, and public viewing of the sky. An additional attraction lies just north of the red-brick and columned planetarium building: a 35-foot terazzo sundial with a brass gnomon centered in a garden featuring a colorful variety of hybrid roses.

In recent years, the Morehead Planetarium has undergone a number of improvements. In 1969, the original planetarium instrument was replaced with a top-of-the-line Zeiss VI projector through a grant from the Morehead Foundation. In 1977, the star theater was extensively renovated with a repainting of the dome, the installation of carpeting and 330 new cushioned seats, and the building of a new projection gallery around the perimeter of the star theater.

In 1982, a massive renovation of the planetarium's technical facilities was completed as a result of a second Morehead Foundation grant. The project involved the replacement and upgrading of audiovisual and production equipment, the construction of a sound studio, and the installation of an MC-10A Media Control System, marketed by Richard Gray, Inc., of San Diego. The new control system is a specialized computer system which provides automated operation of all special and auxiliary effects in the star theater through the use of programmable floppy disks and modularized control hardware.

These modernizations are helping to keep the Morehead Planetarium a gift of lasting value as John Motley Morehead intended. And that insures that North Carolinians are no longer, of all the people in America, the most ignorant of astronomical matters.

Graphics for the All-Sky Projector

by Robert C. Tate
Harper Planetarium
Atlanta, Georgia

This article will discuss methods of producing graphics for the all-sky system.

The fish-eye lens may be easily removed from the projector and used in its original form, as a camera lens. Pictures shot through the lens will project back through it with no distortion. Thus trees, telephone poles, and the edges of buildings project into the dome as vertical lines.

Naturally, this is an excellent way to produce graphics, though a couple of warnings are in order.

1. Expose as if you were shooting the ground--take your readings, in fact, by pointing the camera at the ground. Also make a couple of extra exposures a stop or two open from what you read. If you expose according to sky brightness, your sky will expose properly (with the sun in it) and your skyline will be too dark.

2. Use a tripod to hold the camera, then get out of the field of view.

3. Level the camera with a bubble level available at most hardware stores, or from Edmund #K40,068.

Light level from such photographs often leaves much to be desired. Often the sky is overexposed and thus too bright. In any case, your stars probably won't show in the sky if any daylight sky shots are projected with the all-sky.

Producing art work for the all sky is really quite simple. The idea here is to produce a drawing with distortion built in, photograph the drawing with a regular copy lens, then project it through the fish-eye lens to again remove the distortion.

Nature of the Distortion

For the art work to project properly, it must be produced according to the following rules:

1. The art work is circular.

2. The center of the circle projects to the zenith.

3. The circumference of the circle projects to the base of the dome

4. Meridians in the dome are drawn as straight radial lines from the center of the art work.

5. Lines to be projected parallel to the horizon are arcs concentric to the center of the art work.

Look at figure 1 as an example. In this piece of art work of a house, school, car and distant city the street lights, which are drawn as radial lines, will project perpendicular to the horizon. That is, as parts of the meridians. The roof of the house is drawn as an arc concentric with the center of the art work and will project as a horizontal line parallel with the base of the dome.

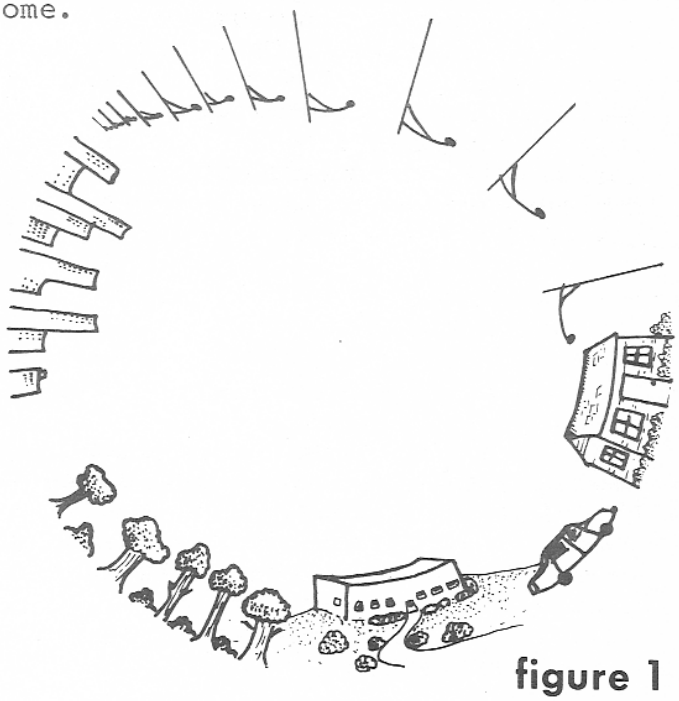


figure 1

Since the house and city are on opposite sides of the art work, they will project on opposite sides of the dome.

Any scene thus drawn can be projected into the dome. Art photographed on Kodalith film will produce simple effects without color. Such scenes, at low light level, look nice with the stars, even without color.

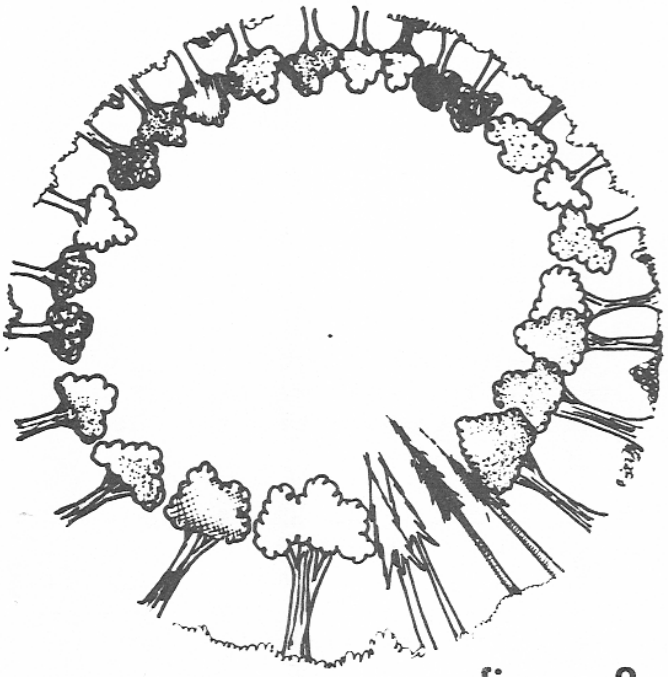


figure 2

Figure 2 is a woods scene. Note that the tallest trees extend over half-way from horizon to zenith and thus will project to about 60° altitude in the dome. This allows little of the sky to show just what an observer would see deep in the woods. Perhaps a better woods scene would have trees rising only a few degrees, as seen from an open field surrounded by woods.

Art work can also be colored with vivid colors, shot and opaqued like other slides, or shot on Kodality and color added with gels or dyes.

Once this art work is produced, it must be shot to the exact scale of the fish-eye lens. When photographed with the Minolta 7.5 mm lens, the image on the film must be exactly 23.455 mm in diameter to produce a full 180° when projected back through the lens.

An easy way to accomplish this is to produce a master slide by shining a bright light toward the fish-eye lens, which has been covered with tracing paper, and taking a shot through the lens. The slide thus produced will be filled and evenly illuminated over the picture area. This slide is then projected back through the copy lens and the position of your art work adjusted so the illuminated area of the master slide just fills the field of your art work. Your copy camera is now at the proper distance from the art work and the copy camera can be loaded with film in place of the master slide.

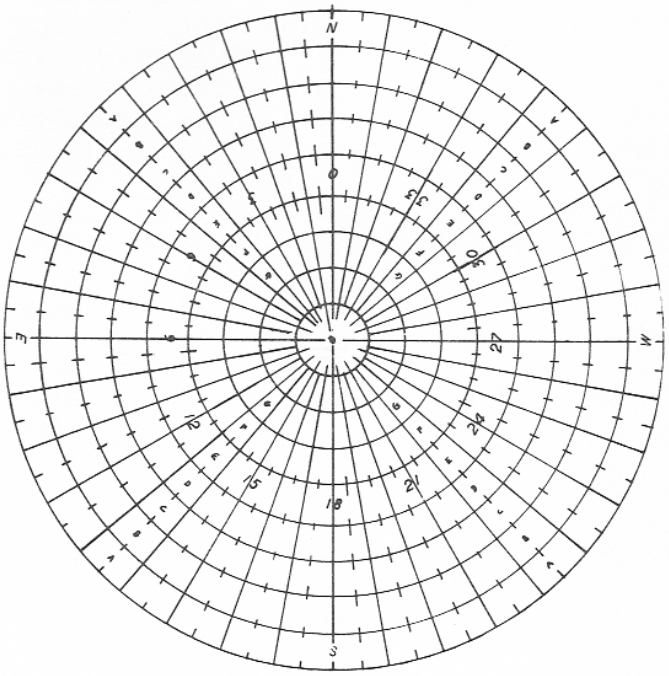


figure 3

Another use for the all-sky is to produce constellation outlines. Figure 3 shows a master grid which can be photographed as outlined above, projected through the all-sky over the star field, and star positions plotted onto a photocopy of the grid, and sketch in your outlines. Now project your grid slide through your copy camera onto the photocopy of the grid to get the scale adjusted properly. Then photograph the tracing of outlines onto Kodalith. This will project exactly over each star in the planetarium when daily motion is set as it was when your stars were plotted.

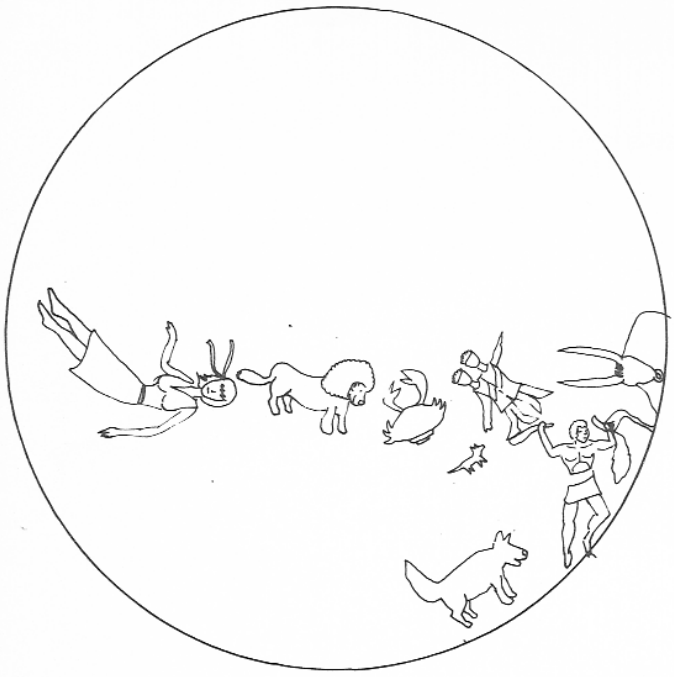


figure 4

All sorts of effects are possible. Consider the following:

* Right ascension and declination over the entire sky.

* Sketch out the sun's path at each season.

* Create a series of arches with the all-sky, then project some stained glass windows beneath them to make a church scene.

* Project super-big words like ZENITH to make a big impact.

* Shoot a close view of a galaxy cluster with your copy camera and project it with the all sky, filling the dome with galaxies.

* Create the interior of the Space Shuttle or some other space ship.

* Any number of simple, fast sky-lines or panoramas.

* An Azimuth scale to go all around your dome (great for looking at sunrise positions).

All of these may be photographed with a normal lens on a copy camera, then projected through the fish-eye lens.

Math

The mathematics of the Minolta fish-eye lens and its distortions is quite simple. The position of the image on the film follows the equi-distant formula, thus

$$y = fw \quad \text{where} \quad (1)$$

y is distance from the center of the film,

f is lens focal length and,

w is angle of the object from the optical axis in radians.

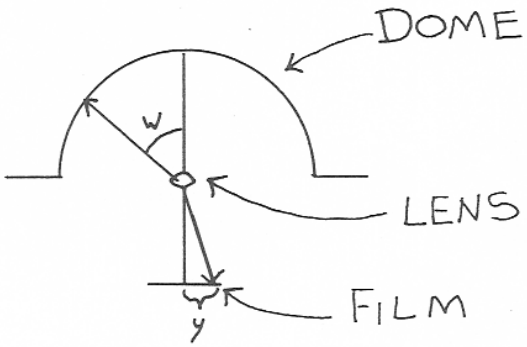


figure 5

Remembering that the field of view is 180° for this lens, the maximum image size can be calculated. Remember 180° = radians

$$y = 7.466\text{mm} \times \text{radians}$$
$$y = 23.455\text{mm}$$

This is the diameter of the image on your film.

This formula can be used to actually plot positions on art work to be photographed by a normal copy camera, then projected back through the all-sky projector.

Note that w is just the zenith angle (90°-altitude). Note also that the linear dimension of one degree at the zenith is exactly the same as the linear dimension on the film of one degree at the horizon. This means that there is no change in size scale as we move from horizon to zenith.

This happy fact allows us to easily plot positions on our art work of objects with known altitudes and azimuths.

Azimuth does not change and can be plotted as if on a compass scale around the circumference of the art work.

Altitude translates into a position on our graph according to the following formula.

$$Z' = \frac{D \times Z}{180} \qquad (2)$$

Where Z' is the distance from the center of our art work.

D is the maximum diameter of our art work (remember it is always a circle and Z is the zenith angle measured in degrees).

This formula is given without derivation to save space. Math buffs can work it out from formula (1) above or contact me for a copy of the derivation.

Z' is measured in the same units as D.

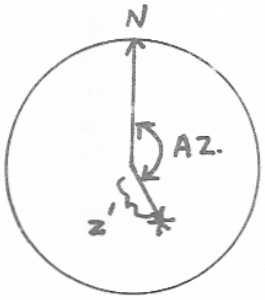


figure 6

You can now accurately plot any sky position on the art work, photograph it with a normal (50mm or so) lens, and have it projected back into the dome in exactly the right place.

Should you wish to get serious about this business, you can use a microcomputer with plotter to do your work for you. You can even convert from Right Ascension and Declination by using the following formula:

L - observer's latitude

D - declination

HA - hour angle

Z - zenith distance

A - azimuth

(3)

$$\cos Z = \sin L \sin D + \cos L \cos D \cos HA$$

(4)

$$\cos A = \frac{\sin D - \sin L \cos Z}{\cos L \sin Z}$$

Use the results in (3) to solve (4).

You still need to know HA to use these formulae. Assuming you will set up your planetarium sky with a known star on the meridian, then that star's Right Ascension becomes the sidereal time, and hour angles for all other stars can be found since

HA = Sidereal Time - R.A.

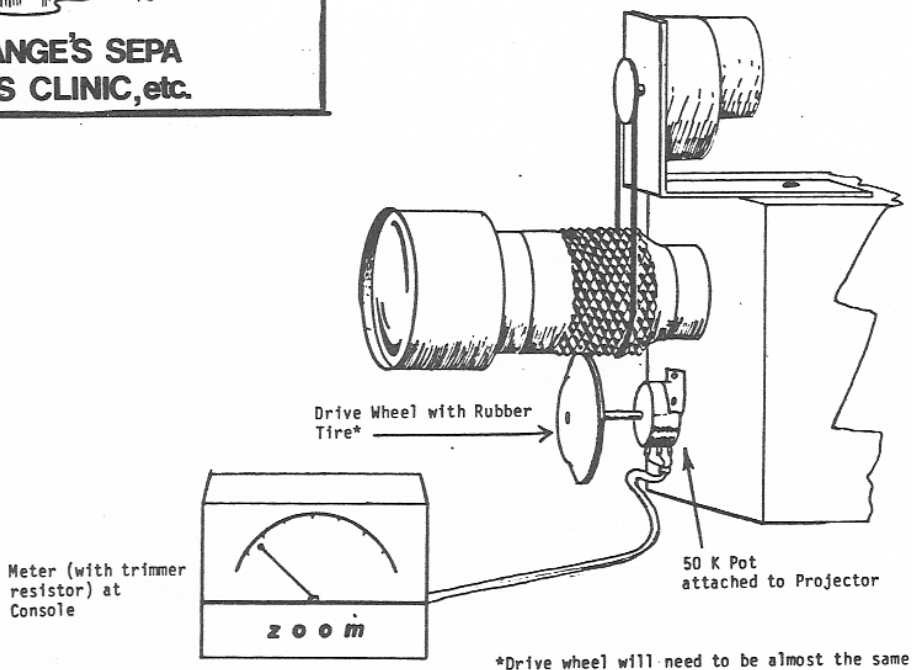
Merely subtracting right ascensions will give the Hour Angle of the object in question. Be careful with signs both here and when calculating arc cosines in (3) and (4).

The results of (4) can be plotted directly while the results of (3) must be run through formula (2) to get your plotted art work position.

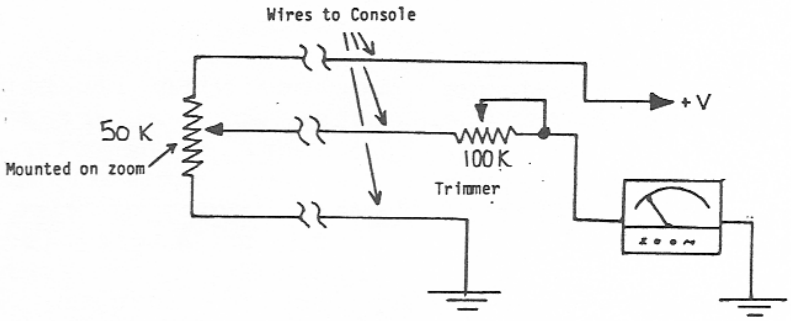
These two numbers are polar coordinates when plotted on the art work which may not plot on your computer. If you need conversion formulae for changing to rectangular coordinates I can supply them.

A note of warning: The use of these formulae will give accurate results only if your all-sky projector is mounted in the center of the dome. Since usually you must mount the projector a few inches off center, your calculated positions will be a little off. I'm still working out the nature of this problem and hope to have it solved soon.

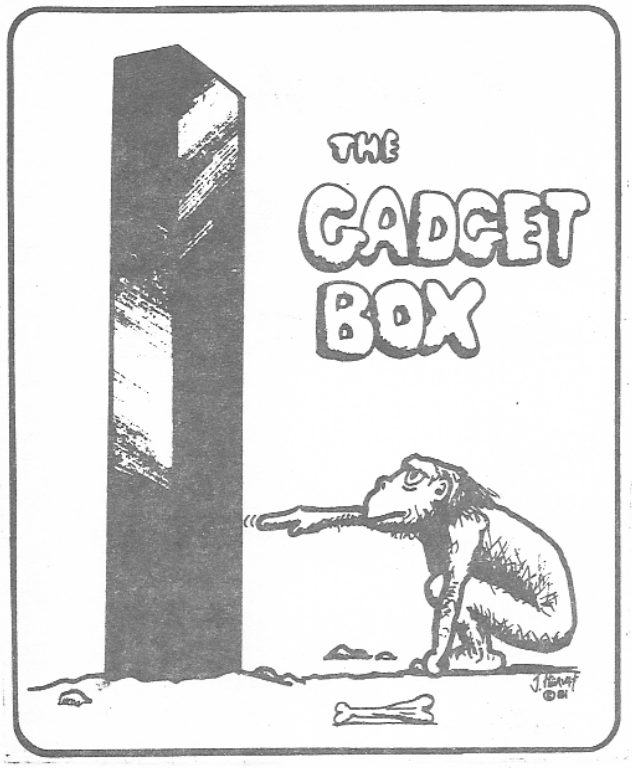
ZOOM POSITION INDICATOR



*Drive wheel will need to be almost the same diameter as the lens knurling so that a 1:1 (approximately) drive ratio results.



NOTE: The values for the resistors shown were chosen for a surplus VU meter movement. If a different meter is used (Radio Shack has several inexpensive ones) the 100 K Trimmer may have to be made larger. Use this trimmer to adjust the meter for full scale deflection at maximum zoom size.



The "Shack" to the Rescue

by Joe Hopkins

If you have been following along by reading my two articles preceding this (and as good little boys and girls I hope you have), you will have assessed your circuit needs (Article 1) and gathered your reference materials (Article 2). You now stand on the threshold of cosmic awareness, ready to actually build the circuit of your dreams. What materials do you use? Where do you get them? What techniques do you use? The answers to these questions are as many and as varied as the hairs on the legs of a sand flea. Do not despair, O budding electron pushers--there is one universal answer: Radio Shack!

Now, don't get me wrong, Radio Shack is not the be-all, end-all of electronic stores. You usually will pay more for parts there than you would from a major supply house such as Newark, Mouser, Allied, etc., and you will not find the wide selection of parts that you would from one of the afore-mentioned major parts houses. However, a smaller variety of parts from which to choose can help keep the budding circuit designer from becoming bewildered, and buying in small quantities usually carries a higher price tag. Radio Shack does serve as a good source for materials to build up a prototype circuit (the major parts houses can be used for subsequent larger production runs), and, since Radio Shack is nationwide, the materials and techniques I describe can be used by planetariums from Billings, Montana (is there a planetarium in Billings?) to Atlanta, Georgia.

Probably the best way to conduct this exercise is by example. Let's say that your next planetarium show's big finale calls for a giant UFO complete with flashing red lights and that you have decided to build the back-and-forth LED flasher circuit you found on page 51 of the Engineer's Notebook II that you bought at Radio Shack for $2.49 from petty cash. You have purchased the four integrated circuit "chips" called for and the various resistors and capacitors (if you aren't sure what a circuit symbol means don't be afraid to ask). Now, how do you put that bag of goodies together into a working circuit?

You first need to decide whether you are going to solder all your circuitry together or go with one of the two main solderless circuit assembly techniques: modular experimenter's breadboard sockets or wire-wrapping. Breadboard sockets are plastic (usually white in color) sockets with literally hundreds of holes in them arranged in rows and columns. The circuit connections are made by stripping the ends of small pieces of wire which are then used to jumper from one set of internally-electrically-connected holes to another, connecting the components in those holes to one another.

(See Fig. 1 on the following page.)

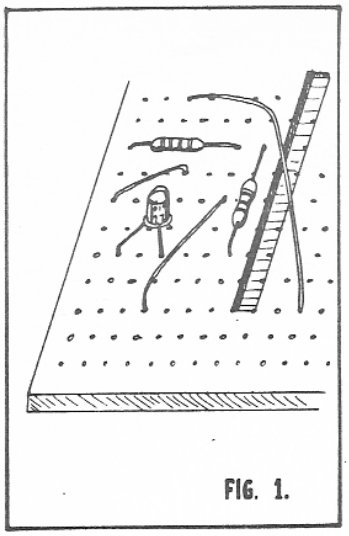


FIG. 1.

This prototyping system has the advantage of being simple and easy; it has the slight disadvantage of not being particularly well-suited for permanent installation, as it is somewhat fragile (I have seen many of these breadboards installed in systems in daily operation, however, don't let it stop you). Wirewrap is another wire-jumper solderless system which wraps the stripped ends of the jumper wires (using a special tool) very tightly around the leads of the components to be connected together, yielding a much stronger and more permanent connection than the previous method. The components are mounted on a piece of perf-board (thin phenolic material with hundreds of holes drilled in it) with their leads sticking through. The jumper wires are then wrapped directly to the component leads. (See Fig. 2)

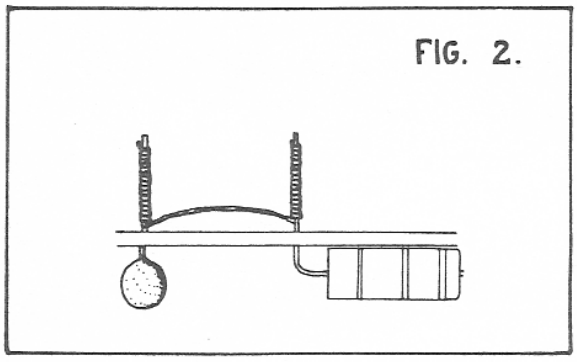


FIG. 2.

Sockets with long leads are used for the integrated circuit "chips." While this system has the advantage of better overall strength than the previous breadboarding method it does require special tools and wire and a fair amount of practice to become proficient.

My favorite method of prototyping involves soldering the components into a grid board and then soldering jumper wires from one grid point to another. (See Fig. 3)

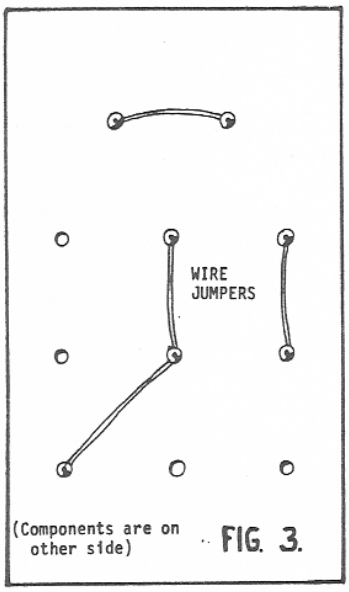


FIG. 3.

This method yields a finished project of maximum strength and (if care is exercised in positioning the jumpers) can be used as a guide to laying out a printed circuit board, a real boon if a number of identical circuits are to be created. This method does require that you be able to solder. Most people who do not solder well do so out of ignorance of proper technique. While countless reams of paper have been used in the publishing of many weighty tomes on this rather simple chore, I prefer to boil it down to the two words necessary for good soldering: clean and hot. If the pieces to be soldered are clean (many component leads and circuit boards need to be cleaned with steel wool before soldering), and the pieces are heated sufficiently before the solder is applied (the solder should melt on the work-piece, not the soldering-iron tip), a good solder joint will result. (See Fig. 4 on the following page).

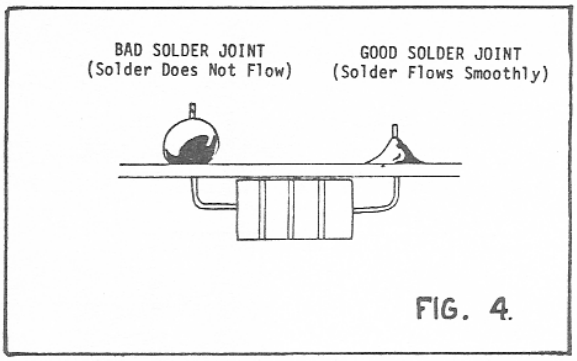


FIG. 4.

Since all solid state components are heat-sensitive and have a well-defined voltage-breakdown point, soldering guns are OUT! (See Fig. 5)

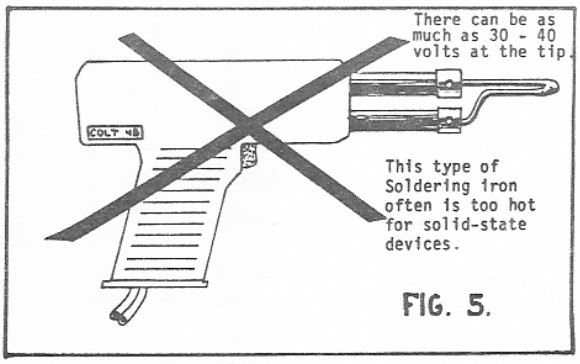


FIG. 5.

Get yourself a nice (approximately 35 watt, 700 degree F) soldering pencil (the magnetic-couples, temperature-controlled, grounded ones are the best) and do some practicing. Use sockets for your integrated circuits and install the chips themselves after the sockets have been soldered in place; use only as much heat as is necessary only for as long as necessary for transistors and diodes since they are solid-state devices and heat-sensitive.

I prefer to solder-connect everything I do so that I don't have tools and materials for several different prototyping techniques cluttering up the place. I think it is a real good idea for you to become proficient at soldering and circuit assembly is a good opportunity to do so.

While the materials presented for the techniques described are all available at Radio Shack, they are also available elsewhere--often in greater variety. By all means, shop around! See what's out there to help you!

To finish up, let's return to our actual example for a moment. You've gathered all your parts for your LED flasher and you've decided upon soldered-grid-board construction. Should you mount all the components at once and hope for the best? Well, a better idea is to divide the circuit into stages and get each stage to work and then connect them. If you look at the output of the 555 oscillator as it connects into the counter circuit you see that it is a natural dividing place as there is only that one connection between the two sections. So divide it there and build and trouble-shoot each half independently. When you're finished you have a neat addition to your static UFO slide and your finale is a real big (bang) success!

One final note before you are returned to the mundane world of crickets. If you need help, it is NO CRIME!!! Ask a good local technician (understand that they are probably very busy) for advice; you can always call me if someone good isn't available--I'm happy to help!

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