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CONTENTS

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6560 Braddock Road
Alexandria, Virginia 22312

Editor's Message

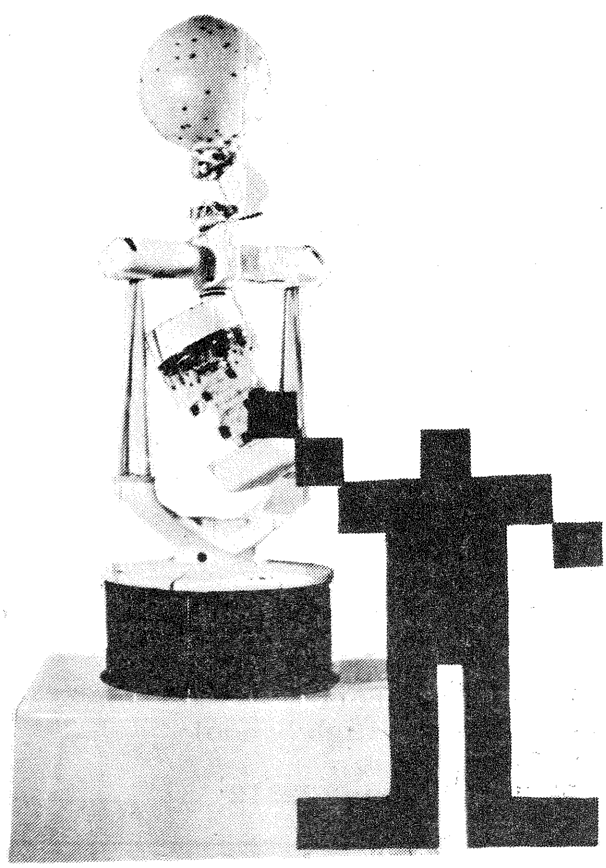
Long overdue but here it is. Because of a combination of problems, not the least of which is poor postal service, your journal is late. This does not mean that this delay will carry through to following issues. It will not. The summer issue is now well into the composing stage and will follow very soon.

You will notice that there is no "Jane's Corner" in this issue. She needs your help. Write to Jane. That in itself will give her something to write about. Tell her what's been going on in your place, pass along the latest joke you've heard, propose marriage, anything, but please, write to her. The address is:

Jane P. Geohegan
4100 West Grace Street
Richmond, Virginia 23230

You need to know that my backlog of material is getting frightfully low. We need short and long articles, serious and not so serious. We can use the scholarly, technical reports as well as the informal, informational type. Please help!

Bill Fagan
Oakton High School Planetarium
2900 Sutton Road
Vienna, Virginia 22180



HERBY NEXT TO HIS INSTRUMENT

Letters to the Editor

Dear Mr. Fagan:

The fall issue (V. 5, No. 3) of THE PLANETARIAN is the last straw!!!

There, sitting in black and white, are two "people" supposedly living on a planet within the cluster, M 13...and one of them is named Herby???

I take gross exception to this free wheeling use of the name Herby. This magnificent name has been used in vain too many times; Shampoo ads, air freshener commercials, bank advertisments, even PLAYGIRL. AND NOW THIS???!!!

I am proud of my name and of my profession as the enclosed photograph shows. And I hope that this blatant use of the good name HERBY will cease.

Sincerely,

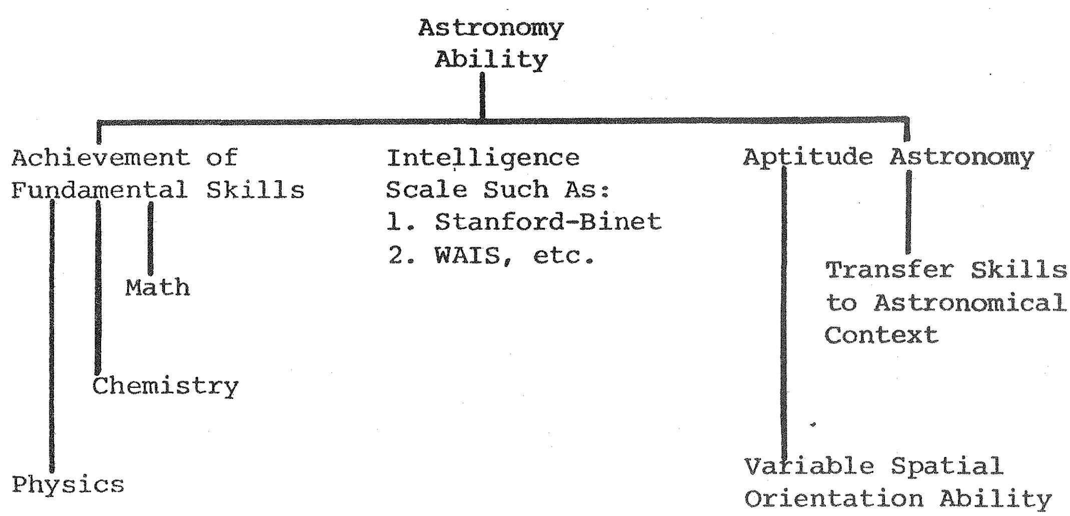
Herbert J. Schwartz
Planetarium Director
Des Moines Center of
Science & Industry

The Construction of a Variable Spatial Orientation Ability Instrument

T. V. Smith, Ph.D.

Introduction

General astronomy is a popular freshman course on many college campuses. Unfortunately, many freshmen do not possess the required level of achievement in fundamental science skills and the ability to relate these skills to an astronomical context. Therefore, an astronomy ability test to predict a student's performance in a general astronomy course would be a desirable instrument. This paper suggests an instrument which would consist of three main categories; (1) intelligence, (2) skill achievement, and (3) astronomy aptitude, each of which in turn would consist of several subdivisions. A chart of the invisioned astronomy ability instrument follows:



The left and center portions of the chart measure the level of achievement in areas of science that a student must possess to be able to comprehend general astronomy and general intelligence. It is a relatively straightforward procedure to decide the level of sophistication required in each of these areas and locate existing scales to measure these factors. The right side of the chart is not as simple because no instruments have yet been constructed specifically to measure either the transfer of the fundamental skills or the Variable Spatial Orientation Ability as related to astronomy. Therefore, it would be necessary to either modify existing tests which are used to measure similar traits in other disciplines or to construct entirely new tests. This paper will not deal with the complete astronomy ability test but instead to concentrate on one small segment; the Variable Spatial Orientation Ability. The purpose of this paper is to define this construct and suggest the design for an instrument to measure it.

Definition of the Construct

The construct, Variable Spatial Orientations, was chosen as a result of the author's past teaching experience which suggests that spatial orientations problems tend to be of unequal difficulty for students in a general astronomy course. The author hypothesizes that individuals possess varying degrees of a trait which will be referred to in this paper as a Variable Spatial Orientation Ability (VSOA). It is defined here as an individual's ability to look at a picture of a three dimensional object and to successfully choose from among several other pictures the one that best resembles the object when it is viewed from a reference point other than the original view. This other reference point could be above, below, behind, to the right or left of the object, or even inside it. Ultimately, the purpose would be to demonstrate that a person who possesses more of this trait, all other things being equal, would do better in astronomy than a person possessing less of the trait.

Variable Spatial Orientation Ability is a must in navigation problems where it is often necessary to assume the earth is a perfect sphere and to imagine one self at the earth's center watching the ships sail across the ocean at the surface. This point of view is referred to here as the "worm's eye view" in contrast to the popular term "bird's eye view." The student needs to have the ability to mentally transfer from one observing position to another in order to understand many astronomical concepts (Werdelin, 1961).

One of the most basic concepts in astronomy is that of the celestial sphere. It can be imagined as a sphere of infinite radius with the earth at the center. The sphere is used to locate and predict the position of celestial objects such as planets, stars, and comets. The astronomy student must be able to correctly locate the position of celestial objects on a diagram of the sphere when the object is viewed from a reference point located anywhere inside or outside of the sphere. The hypothetical construct, Variable Spatial Orientation Ability is critical in determining the extent to which a student can master general astronomy of which the celestial sphere is an important concept.

It should be possible to hypothesize as to the type of behavior that would be exhibited by a person having a substantial amount of this trait. The individual would probably be involved in the physical sciences, engineering, architecture, art or sculpture as compared to literature, music, or business. If the assumptions about the construct and related behaviors are correct, then the validity of the VSOA test could be inspected by administering the instrument to these different categories of people and examining the correlations among them. The construct should correlate positively with behaviors which seem to be related to the trait and negatively with behaviors not demanding this ability.

The character of the construct as defined earlier resembles the visualization factor (V_Z) which is defined as an ability to take an object mentally and move, turn, twist, or invert one or more objects and then to recognize the new position, location, or appearance of the object (Michael, 1950). It is also similar to the space factor (S) which is defined as the ability to appreciate spatial order or arrangement of objects with the subject's own body as the frame of reference. Both of the terms V_Z and S are referred to as space factors and considerable work has been done with space factors in relation to geometrical construction and ability (Michael, 1950). In these investigations the subject is always located outside the geometrical shapes considered. However, in this proposal, the subject can be situated anywhere inside or outside of the geometrical shape.

Psychologists like Guilford, Thurston, and Michael have shown that there are several space factors (V_Z and S are the main ones) existing over and above Spearman's general intelligence factor g (Werdelin, 1961). If the variance of astronomy ability is described in terms of a Venn diagram considering these factors (V_Z and S) as a subset of the Variables Spatial Orientation Ability, the relationship can be shown in Figure 1.

VENN DIAGRAM OF ASTRONOMY ABILITY

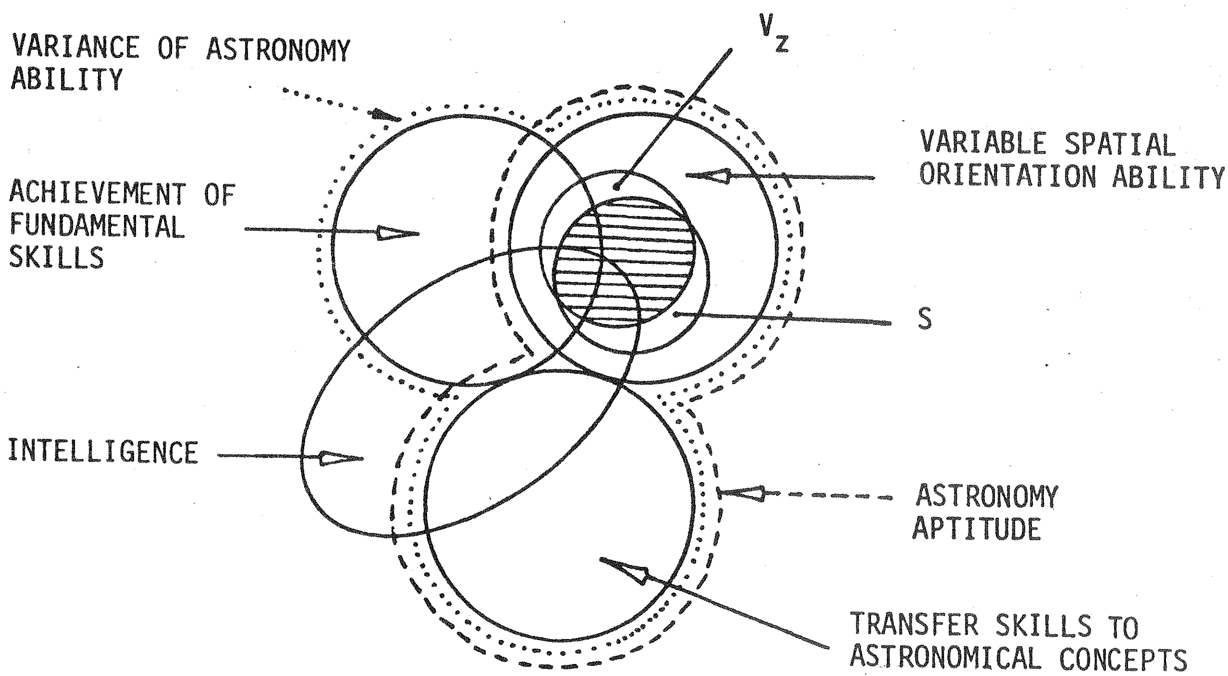


FIGURE 1

Notice the correlation between V_Z and S in Figure 1. They are so highly correlated that in several research studies the investigators have not been able to resolve them into two separate factors (Werdelin, 1961). Therefore, V_Z and S can be considered to approximately represent the same factor. Since the construct proposed here is a logical extension of the construct from which V_Z and S were found, it is possible to conclude that VSOA is a homogeneous construct. As a result this construct can be measured with one highly homogeneous instrument.

Variables Associated with the Construct

The extent to which variables such as intelligence, sex, age, education, socio-economic status, and culture relation to Variable Spatial Orientation can only be hypothesized. An examination of the literature of similar constructs and their correlation with these variables provide a sound basis for extrapolating to the effect of these variables on the construct defined in this paper.

Intelligence. Most constructs are effected to some degree by intelligence. Some intelligence studies have suggested that there is an imagery system in the mind and some of its special operations include the ability to rotate solid objects in imaginal space, to "walk around and inspect" all side of an imagined object, to deform objects, to concatenate objects in diverse geometrical relationships or in bizarre combinations, and to shrink or expand relative sizes of objects (Bower, 1970). The similarity between the imagery system and the proposed construct strongly implies that the variable intelligence effects VSOA. The Venn diagram illustrates the correlation of intelligence as defined by Spearman's g factor and the construct (Werdelin, 1961). Thurstone (1949) has found that the spatial factors (V_Z) and (S) correlate highly with intelligence. Since (V_Z) and (S) are considered as subsets of VSOA, VSOA should also correlate well with intelligence.

Age and Sex. Age, a variable in many constructs, is not important in this study since it is designed for college freshmen. Had it been designed for young children, age would have had to been taken into consideration. Piaget (1952) has observed that children about four to five years of age are in the early stages of spatial development. Thus it would not be possible to measure VSOA on that age group. For older children their development of spatial conception would have to be considered when a test is constructed to measure the extent to which they possess Variable Spatial Orientation Ability.

Sex, another common variable, appears to have little effect in this study. Werdelin (1961) in a study of geometrical ability and the space factors in boys and girls concludes that, in several tests which he conducted, "the mean performance of girls is not inferior to the mean performance of the boys. Any differences between the sexes seems to depend on differences in training, or on the selection of students from various schools used in the study. There are no sex differences in the ability to comprehend the visual structure, to organize it, and to reorganize it. Boys are superior to girls with respect to geometrical construction and abstract and geometrical problem solving. Girls are superior to boys with respect to their ability to prove geometrical theorems but this may be a function of their training (p. 127)."

Another investigator (Boe, 1968) studying the ability of students to perceive the plane sections of solid figures finds that "the significance of the variable sex in the analysis of the drawing method of response data apparently is due to the nature of the response rather than the nature of the task. The significance of sex in drawing is corroborated by the researchers Goodenough & Lewis. The question of the significance of sex in scholastic and intellectual pursuits seems to be debatable. Studies of geometric relationships and of spatial concepts appear to favor the male, while studies of Thorndike suggest the sex differential is not sufficient when compared to the variation within a sex group. Considering these points and the fact that sex was a significant variable only in the drawing response score, it would seem reasonable to support the assumption that sex is an inadequate determinant of achievement in geometric sectioning (p. 419)."

From the investigations of Brown (1954), Werdelin (1961), Smith (1964), and Boe (1968), it can be concluded that sex would not be an important consideration in the construct VSOA. However, in the application of this ability to astronomical concepts, it would appear that the males have a slight advantage but this again may be a result of training.

Education or Training and Socio-economic Status. Brown (1954) has shown that there exists a positive relationship between education or training and the ability of spatial visualization (V_Z). It is logical to assume that within a culture the higher the socio-economic level the higher the education or training level. In the interpretation of VSOA test scores the variables education or training and socio-economic must be considered. Individuals with training or education in abstract drawing, art, or space related hobbies or occupations would probably do better on the VSOA test than those without this particular type of background.

Cultural Influences. Culture influences the construct defined in this paper in the degree to which that culture emphasizes art, scientific education, and abstract thinking. Highly advanced technical cultures would probably have more persons possessing this trait than primitive cultures.

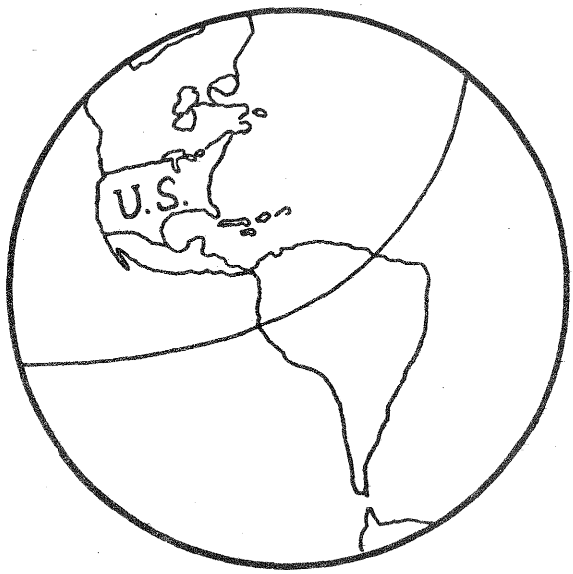
Design of the VSOA Test

The VSOA instrument suggested here is a paper and pencil instrument consisting of multiple-choice type responses. The construction of the test would begin by grouping questions into categories of increasing difficulty. Each group would contain four or five questions. The reason for the ascending difficulty approach is that ultimately it would be desirable to establish a cut-off level above which a score would indicate that the student would be successful in general astronomy. Establishment of this cut-off score may be very difficult or impossible when the interactions of the various factors which make up success in general astronomy are considered.

The instrument is to be constructed of questions similar to those now used in tests on spatial factors except that they would be modified to include reference points inside the geometrical shape. The conclusions being that a student doing well on this type of instrument would have little difficulty when the geometrical shape becomes a celestial sphere or some other astronomical reference system. An example of a typical test question is given in Figure 2.

EXAMPLE TEST QUESTION

After examining the diagram of the earth below, imagine that you are taken to the earth's center and are able to look through the rock to the surface. How would the United States (labeled U.S.) look to you from the center of the earth?



Please answer by circling the diagram below which best shows the UNITED STATES as it would look to you.

DIAGRAM 1

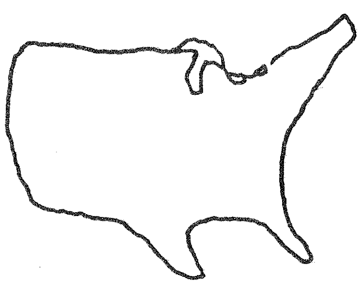


DIAGRAM 2

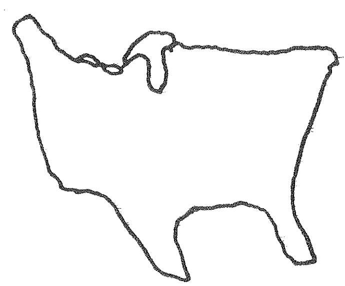


DIAGRAM 3

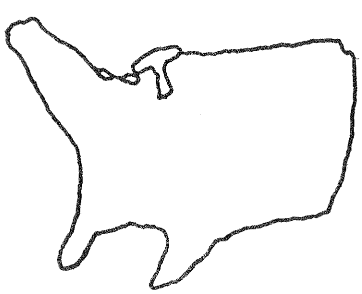


DIAGRAM 4

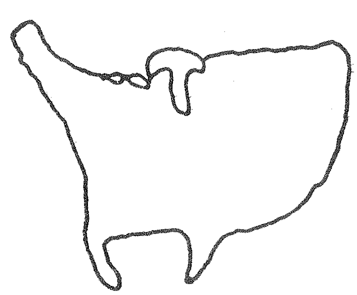


FIGURE 2

Item Analysis and Reliability

After the test questions have been constructed, they should be examined for content validity to insure that the items are representative of the domain they are designed to assess (Flynn, 1972). A pilot test is then formed from the content valid items and administered to a sample representative of the population for whom the test is intended. An item analysis is then performed and those items which correlate very low with the total test score can be eliminated (Nunnally, 1967). This will permit everyone to answer some questions correctly. In compiling the original list of items a sufficient number should be chosen to allow for this elimination. Since the test is designed to contain items of various degrees of difficulty, it will be necessary to form a frequency distribution of the correct number of answers to the items. The items picked for the final instrument should have a normal distribution in terms of difficult and can be selected from the frequency distribution. These items will be arranged in the instrument in terms of increasing difficulty. The reliability of the instrument can be found using the split-half approach with the even-odd classification criterion and the Spearman-Brown equation. Since the construct was hypothesized as being homogeneous, the reliability should be computed using KR-20 in order to examine the internal consistency of the instrument. The reliabilities for ability tests should be in the range .47 to .98 with the median being 0.79 (Helmstadter, 1964). Thus, the reliability of .80 would be adequate for this instrument. If the reliability is too low, more items can be added and then the reliability can be recalculated.

Validity

Once the instrument has been constructed, its content validity still remains to be established. The instrument should be examined by judges to validate that the content area as described by the items is representative of the construct it is designed to measure. The judges should be from the various disciplines in which the construct VSOA is suspected to reside. The construct validity can be examined by a comparison of the scores of different groups on the VSOA test and those obtained on related tests under similar situations. The groups that are hypothesized to have this trait should do better than the groups not having the trait. If the instrument is then used for prediction and it is found that persons who possess large amounts of spatial ability as measured by the spatial ability test also possess large amounts of the hypothesized trait as measured by the VSOA test, it can be concluded that construct validity exists since spatial ability is included in both instruments. For example it was stated that engineers should possess the trait. If this assumption is correct, then there would be a high correlation between the VSOA test and engineering ability tests. The scores on the VSOA test should correlate positively with tests measuring the same or similar traits and negatively with tests measuring abilities not related to the trait.

Related Tests

Although instruments exist which measure various aspects of spatial ability in relation to geometry, no test has been found which could be used to measure the proposed construct. All tests examined were concerned with the "bird's eye view" of geometrical shapes from which spatial ability was then determined. The proposed construct is concerned with both internal and external reference positions in relation to geometric shape. Since the VSOA test can be considered to contain aspects of spatial test, a high correlation between the two instruments should help to establish construct validity.

Establishing a Cut-Off Level

This discussion of a Variable Spatial Orientation Ability Instrument was approached with the eventual goal of establishing a critical success level for this ability. Thus, the point of interest is not in determining if a person's score falls within a range or how he compares to the average of the distribution but instead in the determination of the cut-off level (Anastasai, 1968). To find this point it will be necessary to administer the instrument to students on the first day of general astronomy class and to correlate their score on the test with their final course grade. The procedure will have to be repeated many times with similar groups under like conditions in order to provide enough information from which to establish a cut-off level. Though a point could be found by this approach one would still have little knowledge of interaction effects as mentioned earlier. The best that could be hoped for is that after a large number of VSOA scores have been correlated with class scores, a cut-off point would emerge which would be applicable in most cases. It is possible that a person could have a high VSOA score and still fail astronomy because of a poor understanding of physics and math concepts. While this argument is valid, the author believes the probability of such an occurrence is small because it was hypothesized that the VSOA should correlate highly with science and thus the person should also have the ability to handle the physics and math at the level required in general astronomy. Yet the argument may be raised that an artist could possess this trait and also have a poor science-math background and thus would fail in astronomy. However, if one recalls that the structure chart of astronomy ability had tests of fundamental skills, it would be obvious that problems like the one with the artists are not likely to occur because that type of individual would be prevented from taking the course.

Users of the Instrument

The central theme of this paper is that the VSOA test is a subset of a larger instrument (the astronomy ability test) which will be used by teachers to determine if a student is likely to succeed in general astronomy. If norms on the general population were established for this instrument by the usual methods, it perhaps would provide a better measure of spatial factors than the tests now in existence since it is a more encompassing instrument.

Summary

The ultimate goal of this paper is the construction of an astronomy ability test to predict a student's success from a predictor set of tests measuring achievement and ability. In the present proposal the purpose is to establish one of the predictor set instruments. A hypothetical homogeneous construct, Variable Spatial Orientation Ability (VSOA), is put forth and a hypothesis is made as to the behavior of person's having this trait. Test items are then designed in terms of increasing difficulty and administered in a pilot test. The items are then correlated with total test scores to eliminate unsatisfactory questions. The remaining items are arranged in a frequency distribution from which questions can be selected to produce an instrument which has a normal distribution of items in terms of difficulty. The instrument is then examined for content validity, administered again to sample groups representative of the population and the reliability is calculated by the split-half method using the even-odd criterion. Homogenity is tested using the KR-20 formula. If predetermined levels are met, validity can then be checked, otherwise the instrument will have to be modified by adding more items in order to reach the critical level. Construct validity can be examined by correlating the scores on this instrument with scores on other tests which measure similar traits or the same trait to a lesser degree. The test can be administered to a group of persons hypothesized to have the trait and others that do not examine the result to see if they are negatively correlated as expected.

Constructing a VSOA instrument, validating, and administering it should be straightforward. The apparent strengths and weaknesses of the design have been previously mentioned. The main difficulty will be in relating the VSOA scores in a meaningful way to astronomy ability because of interaction effects. Only through many repeated measures will it be possible to relate VSOA, transfer skills and achievement of fundamental skills in a manner which will allow the prediction of success in general astronomy.

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Letters . . . We Get Letters . . .

DON HALL

The Strasenburgh Planetarium received the following two letters from members of the same audience for a performance of one of the Planetarium's three preschool programs. There's no accounting for taste!

\+ + + + + + +

Dear Sir:

The children and teachers of our school attended your performance of "Space Wizard" on Friday, December 10. We find it necessary to express our disappointment with this production.

The quality performances of the past have been our incentive to prepare the children in school and then give them their first experience of attending the planetarium.

The staff at Trinity feel that the "Space Wizard" program did not measure up to your usual standards. There was a great deal of insignificant banter between Wizard and Narrator and little actual information imparted to the audience.

Please accept our constructive criticism as we have enjoyed your past performances and hope to attend future productions.

Sister Cora Marinaro
Director
Trinity Montessori School, Rochester

\+ + + + + + +

Dear Sirs:

We recently brought our 40 Nursery School children in to see "Space Wizard" and I wanted to let you know how very pleased we are with the program. "Ken" and the Wizard had just the right amount of talking and "trickery" to keep the young children on the edge of their seats and interested in what was going on. It was especially good of them to encourage audience participation (as children of that age will participate invited or not).

Please keep up the excellent quality in programs and personnel and forward to me the times and dates of the pre-school programs for April, 1977 when they are available.

Thank you for caring and sharing.

Kathryn G. Chamberlin (Mrs. David)
Wooden Shoe Cooperative Nursery School
Walworth, New York

A Dialogue: Planetarium Director and Institutional Administrator

or

"A CASE YOU CAN PRESENT TO THOSE WHO HOLD THE PURSE STRINGS"

Jeanne E. Bishop

ADMINISTRATOR: Our institution's funds have been cut, inflation erodes, and after all, what real good is a planetarium anyway?

PLANETARIUM DIRECTOR: At first glance there are a few points which put the planetarium at a disadvantage. Please let me review them. Then I think I can answer your question.

This planetarium was installed as part of the strong national movement for space education during the 1960's. President Eisenhower and Congress established NDEA matching funds and Title III grants to build planetariums, and they mushroomed. Ours was one of them. Our administration (before you) naturally took advantage of such a program, especially since parents and other members of the community were clamoring that the kids needed a lot better understanding of space. The planetarium was a shoe-in, if I may say so. Now I wasn't around then either, but I've seen most of the file materials about those early days. There were high-sounding phrases like, "The planetarium is a space-age theater designed to teach everything you ever wanted to know about space and more." They were all fairly general, and they were mostly supplied by the company who sold the planetarium.

But nobody got around to establishing specific objectives for our planetarium. The planetarium director was given a free rein to develop programs as he thought best. They might be super, but they haven't ever been judged by a set of tailored criteria established by administration and staff. Now, when you look at your other programs which do have such objectives, prepared at the time they were initiated, it is easy to account for the money spent on them. Your cost-effective models, like that PPBS thing I keep hearing about, all pre-suppose initial objectives. You see, what we need to do is together--not me alone, but you and other staff, too--get this planetarium's unique purposes, ones which go with this institution, down in black and white. Then you'll be able to judge our effectiveness.

ADMINISTRATOR: Agreed. I'll arrange a meeting soon. But certainly there must be some general theoretical bases (I like theoretical bases) for keeping a planetarium like ours in business. Why is a planetarium a good idea today? After all, we don't have the national brainpower crisis anymore. We've sent Apollo to the moon and Viking to Mars. U. S. scientists are the best! And haven't I heard that astronomers are so plentiful that many can't get jobs?

PLANETARIUM DIRECTOR: You're right about our scientists and the astronomers. Unfortunately, we now have more qualified people to research the basic ideas of the universe than the public is willing to support. You see, more college teaching-research positions and more observatories would be available if the people in this country were convinced that astronomy is important, like biology, for instance.

ADMINISTRATOR: Well, why is astronomy important?

PLANETARIUM DIRECTOR: Astronomy is important for everyone--not just the few who will do research and extend our frontiers of knowledge. And it's not just a matter of national pride. It happened that the U. S. had got away from teaching astronomy regularly in the schools like they used to. Mostly, it was because that irresponsible Committee of Ten in Physics, Chemistry, and Astronomy in 1892, said astronomy wasn't important enough to be necessary for entrance to college, while every other science was. And the schools dropped it. Why, I could stand here all day and quote experts on why astronomy is important in the life of every human being today. But, of course, your time is limited, so let me distill their thoughts:

1. Astronomy is the richest scientific study of our position in time and space.
2. We are increasingly involved in change of position on earth with expanded travel and in interaction with the environment beyond earth.
3. The state of humankind's astronomical knowledge will sharpen judgment of expenditure for research programs.
4. And very important to the young minds we serve, an individual's outlook on his personal destiny is influenced and crystallized by his understanding of his position in space and time.

Today we need to convey the principles and appreciations related to astronomy as much, if not more so, than ever before. And don't think that everyone now knows astronomy. Why, my colleagues and I get the most trivial questions from adults and kids.

ADMINISTRATOR: OK, OK. But can the planetarium effectively present astronomy?

PLANETARIUM DIRECTOR: I'd like to answer your question partly with a demonstration. Let's step into the planetarium. Now suppose a 9th grade class reaches the point in its astronomy unit in which it is supposed to achieve an understanding of the appearance of the sky at different latitudes. Here is a globe, such as the classroom teacher might use to present the concept. We can discuss an imaginary person at the equator, this latitude, or the North Pole, looking at the sky. Can you imagine the horizon--this sheet of cardboard can be used to show it. Can you get the idea of how the sun will appear to move as I rotate the globe? Now we'll dim the lights and quickly move our viewing location to the North Pole. You will see the sky and the effect of earth rotation as if you were there. See how the sun is taking a low, unsetting path for today, April 1? Isn't that a better way to demonstrate the concept than with the globe alone?

ADMINISTRATOR: Yes, it certainly is. Is there anything else?

PLANETARIUM DIRECTOR: Well, you said that you like theoretical bases for programs. Instead of more demonstrations, let me go over a few.

You've heard of split-brain studies? Well, neuropsychologists have found that different functions are performed by the two different brain hemispheres. Most people are left-hemisphere dominant. They perform the activities of logical analysis, linear thinking, and speech better than the right-brain ones of visual imagery, color discrimination, metaphor, and sensitivity or appreciation. The fact that we cater to left-brain functions probably stunts growth of the right hemisphere, and certainly the minority of individuals who are right-brain dominant are at a disadvantage. Today we give lip service to "the full development of each person's potential", but unless we recognize the brain lateralization, it won't be achieved. The planetarium is an ideal tool which provides spatial imagery and an appeal to the affective dimensions of the right brain. In the planetarium, sense impressions merge with the spoken word, integrating the right and left brain processes. With carefully planned experiences, we can help each individual approach maximum development.

We can't separate the cognitive and affective domains of learning, according to the emminent Swiss psychologist, Jean Piaget. Except in pathological cases, in which the brain hemispheres are surgically separated, the mind functions as a whole in learning. The planetarium is a unique place to engender enthusiasm for astronomy and many other subjects. Have you been to one of our English poetry programs? No? How about Bird Migration for Biology groups? Well, did you make it to Music Appreciation and the Cosmos...most of the staff did. Oh. Well, you might enjoy noting how the students positively respond to these multi-discipline presentations. I'll keep sending you the notices. Perhaps the Board would be interested in a montage of excerpts from these programs in a special showing.

ADMINISTRATOR: Mmmmmm. We might arrange that. Well, you have provided me with some fine theoretical framework for a planetarium's continued existence. Now, I must be going...

PLANETARIUM DIRECTOR: Oh, but there is one more extremely important reason. Piaget, the psychologist I mentioned, has been doing research on developmental reasoning for the past 50 years. He has found that most children and many adults employ concrete rather than abstract thinking patterns. In fact, recent studies have shown that approximately half of the population from tenth grade through adult use the concrete processes. This requires direct experiences, including visual representations instead of merely descriptions. In participation activities in the planetarium--like making records of what is observed--individuals of all ages leave with a very positive feeling of understanding and achievement. For instance, we have our 9th grade students make time-lapse drawings of the sun's path at different latitudes on different dates. We also have role-playing experiences: Social Studies classes imagine they are aboard Columbus' ship and they discover America; science classes become astronomers with differentiated roles in an observatory; and creative writing groups become inspired under moon and stars.

ADMINISTRATOR: You really are excited about the planetarium. I believe that the effectiveness of our planetarium offerings depends to a great extent on who we have running them.

PLANETARIUM DIRECTOR: Uh, well...I do feel I put my best foot forward and not in my mouth, if you know what I mean. But seriously, a study of characteristics of effective planetarium personnel showed that astronomy training, classroom teaching experience, public speaking and writing abilities, and mechanical and scientific aptitudes are important. And enthusiasm, dedication, creativity, flexibility, and humility are helpful, too. As one expert put it, "No other single factor can impose a stronger influence on the effectiveness of a planetarium than the personnel assigned to it."

ADMINISTRATOR: So that high salary (PLANETARIUM DIRECTOR: cough) we pay you is justified. But couldn't we give you a student assistant to take over that extra position you say you need. After all, with you in charge...

PLANETARIUM DIRECTOR: Joseph Chamberlain, Director of Adler, puts it this way: "It is occasionally suggested that anyone who knows some descriptive astronomy and who lectures lucidly can prove successful as a planetarium lecturer. On the contrary, the mastery of subject needs to be so complete that simple words and analogies can be substituted at will for complex or elusive concepts." You see, we really do need a good person to do the job right.

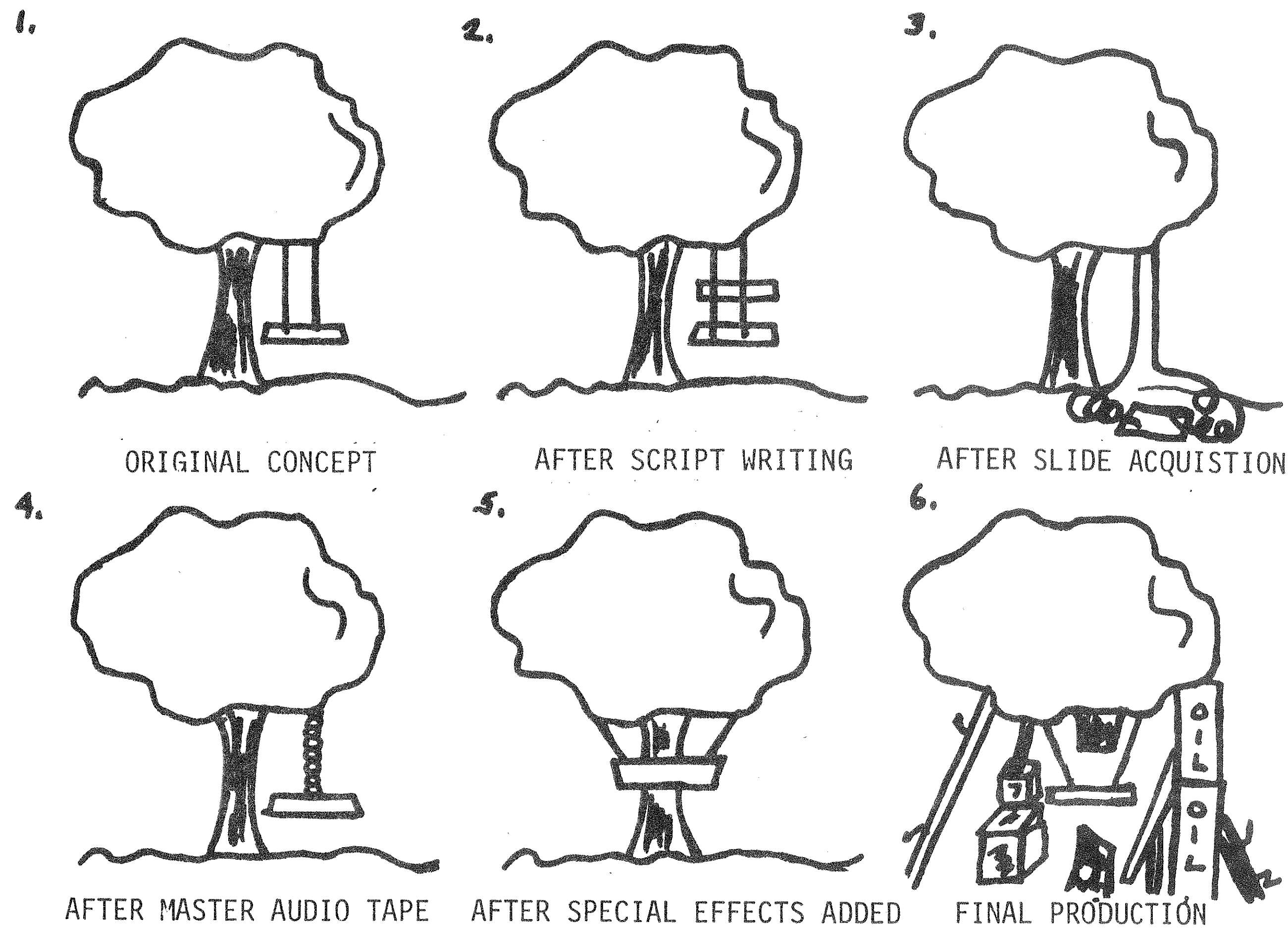
ADMINISTRATOR: Well, suppose we do hire a "good person" to assist you. And suppose we do get that set of specific objectives written. While we're planning this, are there any further recommendations?

PLANETARIUM DIRECTOR: Yes, there are a couple. First, could we initiate channels for frequent interaction among administration, planetarium personnel, and other staff? If ideas and problems can be discussed often, planetarium utilization will be most effective. Second, many times there are several alternative methods or techniques, and we're not sure of the best. It would be extremely worthwhile to occasionally perform an action or "mini-" research project, in which we determine the best program for meeting our specific objectives. This may take a little time, but in the long run, it provides the best offerings.

ADMINISTRATOR: Very interesting. Very interesting. We have had some good ideas. I'll give these matters close attention. (Wait until the other administrators who are considering planetarium cutbacks hear about this! Do you suppose I can afford to be different?) Uh, which way is out?

PLANETARIUM PROGRAMMING

Author unknown



The REAL Constellations of the Zodiac

Lee T. Shapiro

Sooner or later anyone involved with astronomy has contact (or conflict) with astrology or someone interested in astrology. To a great extent the response from the astronomical and planetarium community has been defensive, denying the validity of astrology when asked. There have been some attempts to go on the offensive, such as the recent publication "Objections to Astrology" (Prometheus Books, 1975). However, such clearly anti-astrology publications are probably only read by those who already are non-believers.

To put astrology in the proper perspective, we can do two things to try to remedy the situation. First we must stop spreading astrological information. Yes, I believe all of us have done this even though unintentionally. The prime example and major point of this article is in reference to the band of the zodiac. Consider just the ecliptic. How often have you referred to the twelve constellations that the sun passes through during a year? The number twelve is correct only if one is using astrological constellations. There are thirteen astronomical constellations that cross the ecliptic. Whenever you refer to the zodiac use the number thirteen and name the constellations of the ecliptic (see Table #1). If someone complains that these are not the right constellations, just point out that all constellations are arbitrary and strictly artifical. The ones we use are the official constellations of the International Astronomical Union.

In addition to ceasing our propagation of astrological information, we can also give the public further astronomical information that will hopefully have the effect of raising questions about astrological belief and practive. Table #1 also includes the dates for which the sun is in each constellation of the ecliptic and the number of days it spends in each constellation. If someone asks you what constellation the sun is in on a particular date, use this information and mention that the answer you are giving is the astronomical constellation the sun is in on the date in question. If you cross check between the dates listed here and the standard astrological dates, you will find there are approximately only four dozen dates in common.

Then there is a question of the definition of the zodiac itself. In a quick survey through about ten basic astronomy texts, the definition given was either 8° or 9° on either side of the ecliptic. To be on the conservative side, Table #2 lists those constellations that come within 8° of the ecliptic. (Venus is the only naked eye planet that reaches more than 8° away from the ecliptic.) You can quickly see that there are not 12 constellations of the zodiac but 24. At the appropriate times you can list the non-traditional constellations in which the sun, moon, or planets can be found. The current American Ephemeris & Nautical Almanac and the Atlas Coeli (or some other suitable stellar atlas with constellation boundaries marked) are all that are needed for producing this type of list.

If you include the orbit of Pluto which is tilted at 17^{o} to the ecliptic, then the zodiac also includes the constellations of Bootes, Coma Berenices, Eridanus, and Leo Minor. Using this information, you can have an interesting time incorporating it into shows or creating public displays. If and when astrologers complain, your interest is promoting astronomy, not astrology.

However, there is one caution I would like to mention. If someone asks you whether you believe in astrology, ask them what they mean before you reply. If someone gives me a definition such as "the belief and study of cosmic influences on the earth and its creatures", I can agree that such influences do exist. However, I point out that while it is obvious there are cosmic influences, especially from the sun and the moon, there is no evidence that positions of the heavenly bodies can be used to predict the actions or characteristics of individuals.

Table #1

Astronomical Constellations of the Ecliptic

Constellation	Dates*	# of days
Sagittarius	Dec 18 - Jan 18	32
Capricornus	Jan 19 - Feb 15	28
Aquarius	Feb 16 - Mar 11	24
Pisces	Mar 12 - Apr 18	38
Aries	Apr 19 - May 13	25
Taurus	May 14 - Jun 19	37
Gemini	Jun 20 - Jul 20	31
Cancer	Jul 21 - Aug 9	20
Leo	Aug 10 - Sep 15	37
Virgo	Sep 16 - Oct 30	45
Libra	Oct 31 - Nov 22	23
Scorpius	Nov 23 - Nov 29	7
Ophiuchus	Nov 30 - Dec 17	18

*Dates may fluctuate plus or minus a day from year to year.

Table #2

Astronomical Constellations of the Zodiac

Aquarius	Cetus	Libra	Scorpius
Aries	Corvus	Ophiuchus	Scutum
Auriga	Crater	Orion	Serpens
Cancer	Gemini	Pegasus	Sextans
Canis Minor	Hydra	Pisces	Taurus
Capricornus	Leo	Sagittarius	Virgo

Acadia Park Astronomy Session

Jeanne E. Bishop

Where's Uncle Herman?...Rusty!...This is like a parade...I feel like I'm following the pied piper...stumble... Martha, is that you?...Rustle, rustle, bump...Don't step on my blanket...Ouch!

It was in this manner that about 300 of us climbed over rocks of Cadillac Mountain from the parking lot to an east-facing windswept perch. The hejira took place under a dipping first quarter moon and beautiful stars on August 31, the last astronomy naturalist presentation of Acadia National Park's Season. Near Bar Harbor, Maine, overlooking the glacially submerged coastline of the Atlantic, this was a delightful spot to learn astronomy as well as many other facets of natural history.

On a night when the thermometer had dipped to about 35°F, Naturalist Jan Zirvanski gave an unforgettable performance. With a Baltic accent (he left out unexciting adjectives), he flashed from joke to joke, inserting bits of astronomical wisdom. He bellowed into a microphone with an electronic pick-up. Hunkering in the cold, facing Polaris (at an altitude of 44°) he announced, "This is my final hour."

But he didn't start with the north circumpolar group. For an opener he asked everyone to find the moon. When the laughter died and people really had become better acquainted with the moon's position and phase (a contrail was beautiful by its light), he led us through the visible Zodiac. I was glad to hear him use the astronomically correct Scorpius as opposed to the astrological Scorpio.

Next came Pegasus, Andromeda, and Perseus. Conveniently, an airplane passed near M-31 to mark the location of his reference to a neighbor galaxy. He used lighthouse and even boats to indicate east and northeast azimuths, and a powerful flashlight beam was a reasonable pointer.

Bootes was an ice cream cone; Hercules, a butterfly. He used the names of first-magnitude stars and asked us to remember--Arcturus, Capella, Vega, Altair, Deneb, Amtares. He urged people to help their neighbors. "Keep warm as well as learn stars...share your body heat." A little girl behind me said, "What's that?"

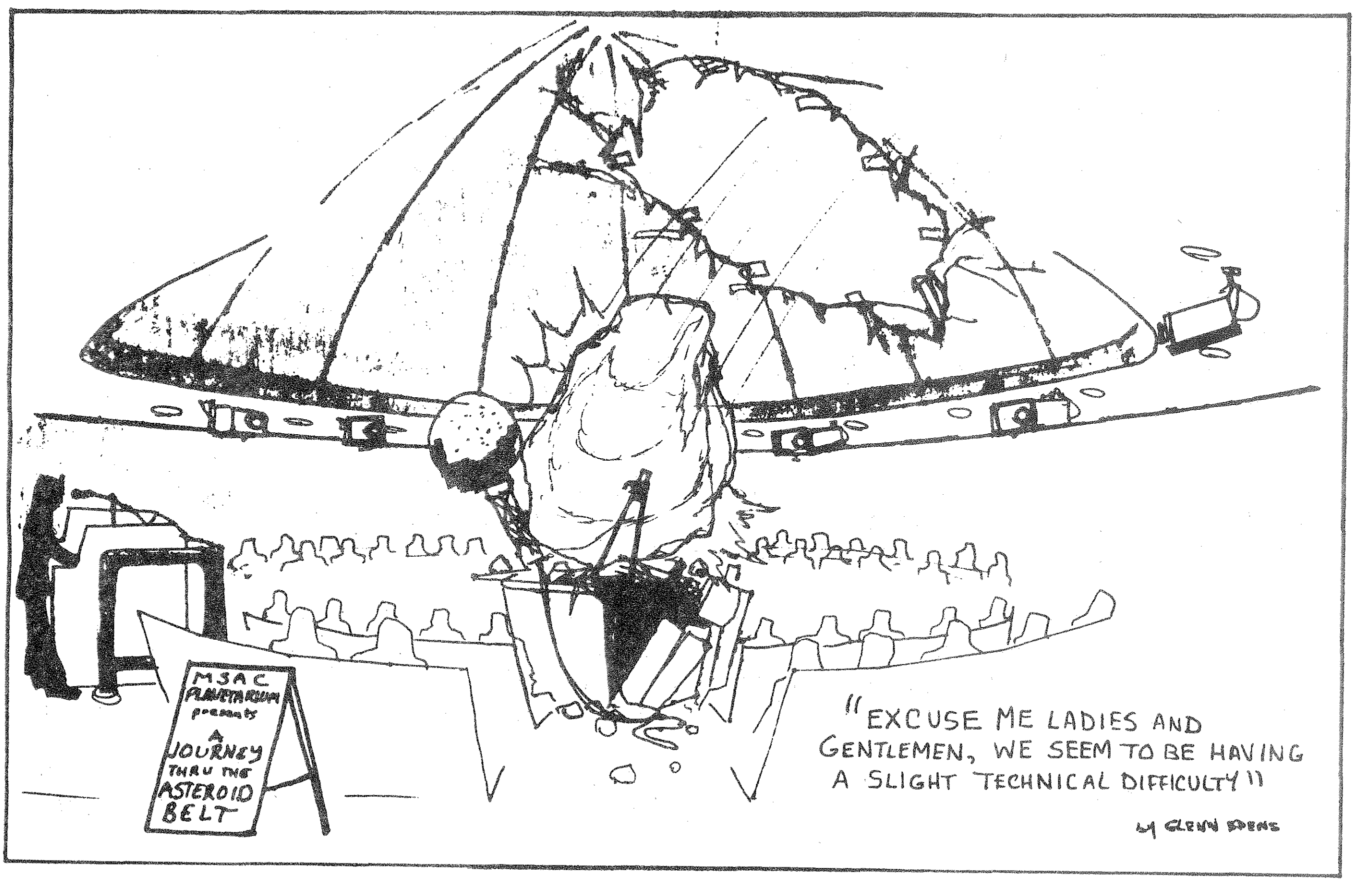
"Do you see the seven stars?" he said, pointing to the Big Dipper. Responses filled the night air: "Yes...No...Six...Nine...Four...Eight...There's another dipper, isn't there?...It's so big!..."

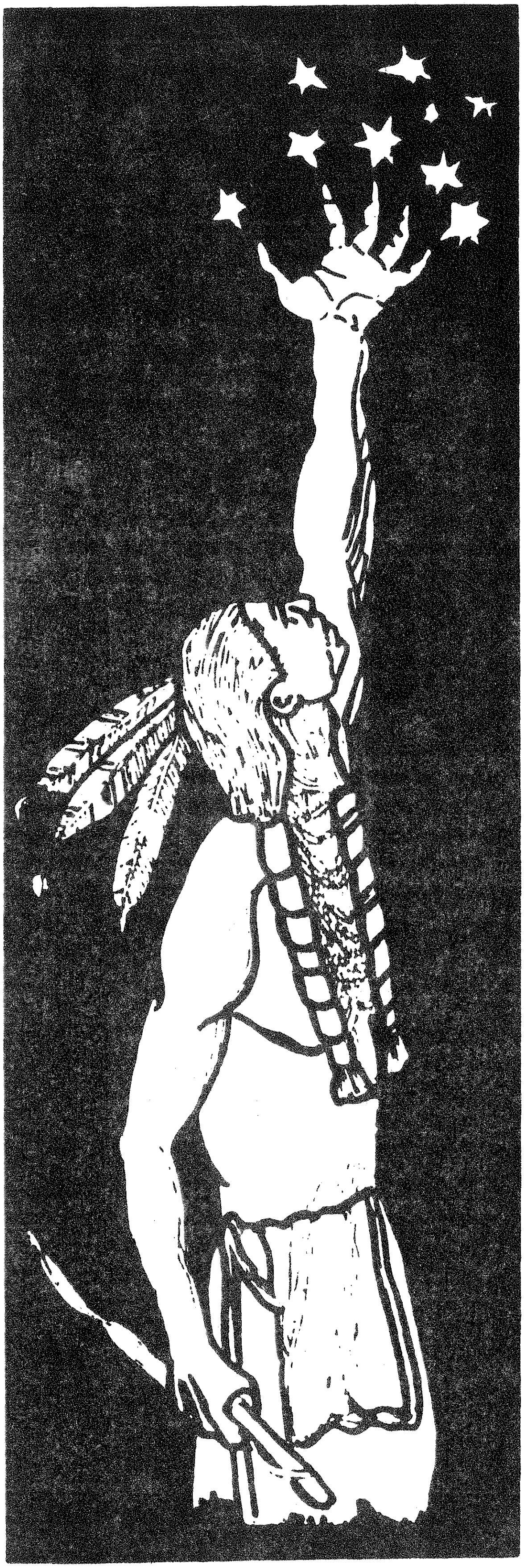
Jan's only myth was the standard one of Zeus and Callisto about Ursa Major, told in a very unstandard way. He called it his "tale of tails" and noted that he included it because it was his job to "put you asleep." I don't think he succeeded. Children made happy sounds as he embellished the story, and the outcome of stretched tails to make the visible Dipper handles was a climax everyone enjoyed.

"Now I give you a little test. If you flunk, you get to stay all night on mountain and pay $25 fee for camping without permit." He pointed to Arcturus with his flashlight beam. Someone gave its name, and others repeated. Then he asked for the constellations of the Summer Triangle. A few seemed to give complete names, but many knew the common ones. "Now," he said, "the hard one. You get this; we let you go home...Point to moon." The moon was just setting over the mountains, and people had to stand to see it clearly--A very clever end to the session.

About twenty stayed to ask questions like, "Have you ever seen a UFO?" "No, never," was his succinct reply."

The park programs attract people interested in nature in all her various forms. It is great to see that astronomy has finally joined the offerings of geology, ecology, tide-pool exploration, and plant and bird identification. In a tide-pool walk, the naturalist went into great detail on the astronomical cause of tides--a feature absent in such a walk I took four years ago. Thanks to the work of Von Del Chamberlain and others, this ideal--for us concerned with astronomy interpretation--has become a reality.





Iroquois Star Myths

E. Q. & C. J. Carr

When the Pleiades appeared on the Northeast horizon at dusk in the Moon of the Hunter, the Cayuga of the Iroquois Nation knew it was time to gather in their harvest and prepare for the winter. Only in the winter, in the months of the Cold Moon, the Wolf Moon and the Hunger Moon when the god of the North Wind shook the lodge in his fury... tore at the skin curtains of the doorways...piled snow in high drifts...only then, was it the Story-telling Moon, the Moon of the Northern Lights.

These stories had many variants, fitted to circumstance by the tradition of an Iroquois tribe, according to the natural ability and ken of the individual storyteller, it seems certain...and molded by the era, for sure. They were "naming" sessions. Terrors, uncertainties, unknowns somehow became more bearable when they are named. They were moral tales...and they were fun.

Consider two variants of those Iroquois stories of the Pleiades: "The pleasant autumn days passed on. The lodges had been built and hunting had prospered, when the children took a fancy to dance for their own amusement. They were getting lonesome, having little to do while the others were busy, and so they met daily in a quiet spot by the lake to have what they called their jolly dance, and very jolly they made it.

"They had done this for quite a time, when one day a very old man came to them. They had seen no one like him before. He was dressed in white feathers, and his white hair shone like silver. If his appearance was strange, his words were unpleasant as well. He told them they must stop their dancing or evil would happen to them. Little did the children heed and nothing did they say. They were intent on their sports, and again and again did the old man appear and repeat his warning. They danced on.

"The mere dances did not afford all the enjoyment the children wished, and a little boy, who liked a good dinner, suggested a feast the next they met. The food must come from their parents, of course, and all these were asked for this when they returned home. 'You will waste and spoil good victuals,' said one. 'You can eat at home as you should,' said another. 'I have no time for such nonsense,' said a third, and so they got nothing at all. Sorry as they were for this, they met and danced as before. A little to eat after each dance would have made them happy indeed. Empty stomachs bring no joy.

"One day, as they danced, they found themselves rising little by little into the air, their heads being light through hunger. How this came about they did not know, but one said, 'Do not look back for something strange is taking place.' A woman, too, saw them rise and called them back, but with no effect. They still rose slowly from the earth. She ran to the camp, and all rushed out with food of every kind, calling piteously after them. The children would not---indeed could not return. One did merely look back and he became a falling star. The others reached the sky, and are now what we call the Pleiades, and to the Onondagas, 'Oot-kwa-tah'. Every falling or shooting star recalls the story to them, but the seven stars shine on continuously, a merry band of dancing children." (Beauchamp)

"When the earth and sky were new, there lived seven little brothers. They loved to play and dance in the forest.

"Once at twilight, returning to their longhouse from the forest, they heard from far, far away the sound of someone singing. The song was not like any song they had ever heard before. It was so beautiful, so mysterious the seven brothers completely forgot about going home. Instead they danced off in the direction of the song.

"As the little boys danced, their feet seemed to grow lighter. Suddenly night came. Then, before long, they could see the forest and the great longhouses of their people stretched out far below them in the moonlight. They saw that they were dancing right up in the sky. Higher and higher they danced, and the song grew louder and sweeter still.

"'I came,' sang the sweet voice, 'for a hunter pursued me, and now I am lost in the sky. But sleep, my little ones, in your warm dark cave. I will watch over you here in the sky.'

"Then the brothers saw a great black bear. She had a long tail made of stars, and she wore a necklace and belt made of white and shining clamshells. Stars twinkled at her nose and her toes, and the clamshells, too, sparkled like bright stars. It was she who was singing the lullaby the boys had heard, and they danced closer to her. The great bear's lullaby was beautiful, and they danced a long time to it. But at last they wanted to go home, for it was very late, but they did not remember the way. They begged the moon to show them how to go back to their longhouse, but the moon only smiled and said: 'This is your home now, my children. We welcome you, I and the stars, for we enjoy watching you dance.' And the boys went on dancing, and strangely enough, they found that they did not grow tired at all.

"The bear's song grew louder and sweeter. Behind each boy a bright star grew, and the moon smiled at their dance. Then the smallest star boy heard a tiny voice from far away. Someone was crying and calling his name. Over the sound of the bear's song and of his brothers' dancing feet he listened, and he heard the distant voice again. It was his mother's voice. The smallest boy began to run as fast as he could go, with the bright star he was wearing making a shining trail behind him.

"'Come back, come back,' cried his brothers and the moon, but the little boy raced away from them. Down he flew, past the eagle's nest, past the clouds, and closer and closer to the earth, as the sound of his mother calling him grew louder and louder. Soon he could see her. She could almost touch his hand. Then he landed on the earth. But where he landed there was no boy. There was only a hole, the kind a star makes when it falls. His mother cried still harder when she saw the fallen star. Then she looked up and saw her other boys dancing in the sky.

"'Stay there. Stay there,' she called to them over the great bear's song, for she did not want them to fall, too. They heard her, as they danced far away and high in the sky, and they nodded their heads to show her they would obey.

"The mother wept for the fallen star, and where her warm tears fell, a little green shoot sprang up. Higher and higher the green shoot grew.

"It was the smallest brother reaching for the sky, so he could be with his brothers again.

"Higher and higher it grew, until it reached where the brothers danced and the great bear sang.

"'Welcome, dear brother,' said the dancing star boys to the tall pine tree who came to join them.

"The pine tree is still there, the tallest tree in the forest. And you can see the brothers dancing even now, in the night sky, while the great bear sings her little bears to sleep." (Rockwell)

References

Beauchamp, Rev. William M., Iroquois Folk Lore, Empire State Historical Publication XXXI, Ira J. Friedman, Inc., Port Washington, NY (1922)

Rockwell, Anne, The Dancing Stars, Thomas Y. Crowell Company, NY (1972)

CONCHY by James Childress

Indian Moons

Everett Q. Carr

Indian pictographs representing time are delightful in their simplicity and expressiveness. The moon crescent symbol was often accompanied by a figure at the concave opening of the crescent. One group of pictographs designating the month as well as time symbols is given in the illustrations. (1)

Ruth Roberts, in her work in compiling Indian Moons for "The Story of the American Indian - The Legend of the Twelve Moons" makes a distinction by formalizing the moon designations as "The Full Moon Of....". Roberts' compilation is given below.

JANUARY	-	THE FULL MOON OF THE FROST ON THE TREE
FEBRUARY	-	THE FULL MOON OF THE WOLF GROWN HUNGRY
MARCH	-	THE FULL MOON OF THE NEW SPRING WALKING
APRIL	-	THE FULL MOON OF THE GREEN GRASS GROWING
MAY	-	THE FULL MOON OF THE WOODLANDS SINGING
JUNE	-	THE FULL MOON OF THE WILD ROSE REDDENING
JULY	-	THE FULL MOON OF THE THUNDER RUMBLING
AUGUST	-	THE FULL MOON OF THE SEED PODS RIPENING
SEPTEMBER	-	THE FULL MOON OF THE HARVEST GATHERING
OCTOBER	-	THE FULL MOON OF THE WEST WIND RAGING
NOVEMBER	-	THE FULL MOON OF THE TIRED HUNTER
DECEMBER	-	THE FULL MOON OF THE LONG SNOW FALLING

Roberts has written the music and book for a record of the same title as well as vocal and orchestral scores for performance of the work by students in grades 4 - 9. (2)

The Hopi Indians of the southwestern United States designated their months generally according to agricultural tasks in a system described by Stephen in his "Hopi Journal". (3)

November, ke' lě.	Sparrow hawk, novice, initiate. The fields were cleared for the next year's planting.
December, kya-.	Various modifiers to kya-, imply most sacred, undesirable, afraid; no work is done in this moon. Chief Crow Wing referred to this as the dangerous moon, "witches are around everywhere". Anyone

December (con't.)	visiting at night should smear ashes on his forehead and chest. Pinon gum should be put on infant's forehead and chest so that old man Moon will not make off with it. There should be no hunt, rabbits would weep.
January, pa mü-iya-wüh.	Moisture moon.
February, powa.	Purification of the growing plants in the kiva with ash on a feather.
March, ü-shü.	The first whistling of wind of warmth also called the cactus moon because food was scarce and the cactus the only food available.
April, kwiya'o.	Wind breaks were set to protect the stems of young plants from the winds of spring.
May, haki'ton.	A waiting Moon. Corn is planted.
June, ü'üsa.	Planting Moon or the Novice Moon, Plants are young like novices.
July, kya-.	The Hoe Moon, plants are cultivated.
August, pa-.	The summer Rain Moon.
September, tuho'osh.	Carrying the burden of the harvest or the Corn Husking Moon.

Stephen also reported in 1883-4 that there were 16 moons in the Hopi working year. Each year divided into two lesser years of eight Moons each. The names designated were:

First Lesser Year

November	-	Sparrow hawk, the smallest Moon
December	-	Great Moon also Snow Moon
January	-	Water Moon
February	-	Sprouting Moon
March	-	Cactus Moon
April	-	West wind Moon, dreaded for the possible frost that nips the sprouting grasses; also the waiting Moon when it's too cold to plant.
May	-	Planting Moon

The Second Lesser year begins with July, Kili, or the sparrow hawk and ends in February. Every Fourth Lesser year begins in November, covering a period of twenty-four months and this is called the year of the Great Moon. The Kachinas reckoned their feasts by a year of 13 moons and their Keli only coincided with the secular Keli once in thirteen years, which was called the "Glad year".

The Natchez of the Mississippi Valley began their year in March and each designation is for a lunar month. (4). There are thirteen months in that year.

1. March - Deer
2. Month of the Strawberry
3. Month of Little Corn
4. Month of the Watermelon
5. Month of the Peach (July)
6. Mulberry Month
7. Great Corn Month (maize)
8. Turkey Month (October)
9. Bison Month
10. Bear Month
11. Cold Meal Month (January)
12. Chestnut Month
13. Nut Month, when nuts are broken to make break at the close of winter - to make bread because supplies are low.

Lillian Budd has gathered the legends of the moons of many tribes. (5). Around campfires in the open, in the tepee or the longhouse of the woodlands, the stories were told over the centuries after the original migrants who crossed the Bering straight land bridges, perhaps 40,000 years ago. Pressed south by the cold of the most recent ice age that covered Canada and the northern United States with glaciers, the Moon was the timekeeper. They watched the skys and the regular procession of the seasons, kept track of the days on carving sticks. Notches for days, a crescent, a half moon, a full moon were carved for the lunar cycle of time the Indians called a "moon".

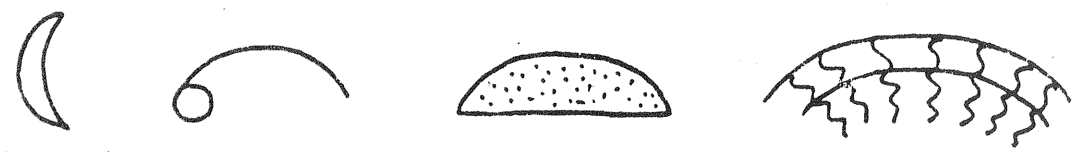
The Moon was a many-storied moon told in the winter for the summer was too busy. When the wind howled and the snow grew deep, the story filled the time; it was a teaching tool; it preserved tribal culture. The Moons of Lillian Budd's research are:

SPRING	Worm Moon (Panamint)
	Planters Moon (Mandan)
	Flower Moon (Salish)
SUMMER	Lovers Moon (Ojibwa)
	Blood Moon (Okangon)
	Corn Moon (Zuni)
	Sturgeon Moon (Ottawa)
AUTUMN	Harvest Moon (Sauk)
	Hunters Moon (Narragansett)
	Beaver Moon (Seneca)
WINTER	Cold Moon (Penobscot)
	Wolf Moon (Passamaquoddy)
	Hunger Moon (Passamaquoddy)

The possibilities of Indian programs anchored in Moon lore offer opportunities for multidiscipline programming. Color for example meant many things to the Indians.

RED	-	Blood, South
WHITE	-	Winter, Death, East
BLUE	-	Sky, Day, Water, West
BLACK	-	Night
YELLOW	-	Sun, Day, East, Sunrise, North
GREEN	-	Earth, Summer West

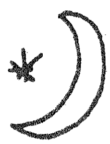
TIME PICTOGRAPHS

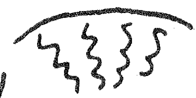


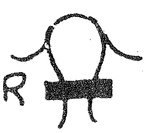
MONTH DAY NIGHT YEAR

MOONS - WITH MONTH SIGNS

SIGNS ARE PLACED AT * OF MOON CRESCENT



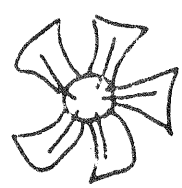
JANUARY - SNOW 

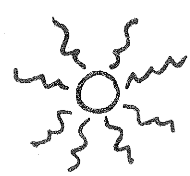
FEBRUARY - HUNGER 

MARCH - CROW 

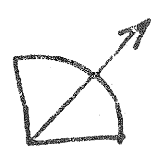
APRIL - GRASS 

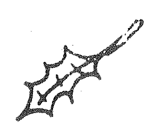
MAY - PLANTING 

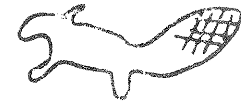
JUNE - ROSE 

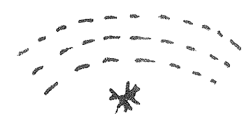
JULY - HEAT 

AUGUST - THUNDER 

SEPTEMBER - HUNTING 

OCTOBER - LEAF FALL 

NOVEMBER - BEAVER 

DECEMBER - LONG NIGHT 

The illustrations in the work of Hyemeyohsts Storm show the richness of material available in color, form and Indian symbology. (6). Storm's explanation of the Medicine Wheel as a meaning and a way of life when taken with Eddy's research about the astronomical significance of the large number of Medicine Wheels in the northern United States and Canada show the breadth and significance of recent scholarship.

In the Algonquin and Abenaki traditions, Marian Smith wrote ".. from the Land of the White Rabbit - the Kingdom of Wabasso, Kabibonokka, God of the North Wind leaving his ledge of snowdrifts, up among the icebergs, shook the lodge poles in his fury; flapped the curtains of the doorways. And his hair with snow besprinkled, streaming behind his head river-like, a black wintry river. Chief Swimming Otter told Little Red Wolf, 'This, my son, is the Moon of the Northern Lights'- the moon of the story telling". (7)

FOOTNOTES

1. Simmonds, Robert T., State University at Oneonta, NY. Dr. Simmonds kindly permitted me to copy his sketches made a number of years ago. Unfortunately his notes did not include the original source.
2. Roberts, Ruth, The Story of the American Indian, The Legend of the Twelve Moons; a unique recording from Golden Records, LP340 with Richard Kiley. Also a package of the recording, vocal and orchestral scores for student performance, grades 4 - 9: #MBP-102 (Michael Brent Publications Inc., Box 1186, Port Chester, NY 10573). There is also a set of four film strips totaling 205 frames. (Roberts reported that her references and bibliography were destroyed in a recent fire.)
3. Stephen, Alexander M., The Hopi Journal, Editor, Elsie Clews Parsons (1969) AMS Press Inc., New York, NY 10003. Parsons comments that the 16 month cycle was probably archaic.
4. Judson, Katherine B., Myths and Legends of the Mississippi Valley and the Great Lakes, (1914) AC McClure & Co., Chicago.
5. Budd, Lillian, Full Moons - Indian Legends of the Seasons, (1971) Rand McNally & Co., NY
6. Storm, Hyemeyohsts, Seven Arrows, (1972) Harper and Row, NY
7. Smith, Marian Whitney, Algonquin and Abenaki Indian Myths and Legends (Publisher unknown)

SURVEY

A SURVEY OF SELECTED 40 FOOT PLANETARIUMS by Herbert J. Schwartz

Just before the New Year, I was approached by my board to find out how The Sargent Planetarium compared with other planetariums in the same situation. Of course I told them to look no farther as the Sargent Planetarium is at least the best on Earth, if not in the Universe. And that I was overworked, underpaid and under staffed.

Somehow, they didn't accept this and asked me to call other Planetaria and find out in numerical terms how we compared as far as, number of seats, total weekly programming, number of staff, their salaries, and annual budget. As you look through this survey you will find other information besides this. The other material included were items I had a personal interest in, and this too has been included here.

My thanks to all who participated. All answered the questions candidly and unhesitantly. It was a pleasure to talk to all of you and the friendship shown to me with this project has once again convinced me that I am in the best of professions. A special thanks goes to my SR-56 calculator without which this report would have been impossible.

Enough of this dribble!

I called 14 planetariums. These were listed in the last CATNAP and were listed as a part of a museum or science center. My criteria were that the planetarium had to have a 40 foot diameter dome and that it had to be a part of a museum or science center. Two planetaria later did not fit these criteria and their figures have not been included.

Salaries and budgets were computed from an "as of this moment" basis, unless the figures for 1977 were known, in which case they were used. In short, this report uses figures from two fiscal years, as their starting dates vary from place to place. Salaries are based upon a 12 month year.

If there were two assistants at the same level salary, one was used in each of the two "Assistants" categories.

Budgets that did not include salaries, had their full time salaries added on. I might add that this heading is not fair to at least two installations as they have to pay for their own utilities and one of those two occupies their own building and must pay for the additional staff.

Under PROGRAMMING, I took the maximum scheduled programming. It is understood that if more people are available for shows, additional shows are given.

As with all surveys, this one is not perfect. Each installation has its own special problems. Once again, my personal thanks to all who participated.

A SURVEY OF SELECTED 40' PLANETARIUMS

Physical Plant

Instruments:	# Used	Manufacturer:
Model C	1	SPITZ
A-3-P	2	SPITZ
A-4	1	SPITZ
A-4-RPY	2	SPITZ
STP	2	SPITZ
512	1	SPITZ
Minolta	1	MINOLTA
M-1	2	GOTO (before Spitz)

SPITZ 75%
Other 25%

Mean # of TOTAL seats: 141

Unidirectional seating: 7 facilities (58%)
Circular seating: 5 facilities (42%)

Mean # of UNIDIRECTIONA: seats: 126
Mean # of CIRCULAR seats: 162

STAFF

Mean # of TOTAL staff for all facilities: 4.2 persons per Planetarium
Mean # of FULL TIME staff for all facilities: 2.4 persons per Planetarium

# of Staff	1	2	3	4	< 4
facilities in each category employing FULL TIME persons	4	3	2	2	1
FULL + PART TIME	2	1	3	2	4

Of the 12 facilities: 8 or 67% used volunteer help.

PROGRAMMING

Maximum weekly scheduled school shows

Shows	10 or less	11-15	16-20	21-25	26-30	greater than 30
# of facilities	2	3	3	1	2	1

Mean: 19.7 school shows per week

Of the 12 facilities, 5 or 42% tape some part or all of their school shows

Maximum weekly scheduled public shows

Shows	0-5	6-10	11-15	16-20	21-25	26-30	greater than 30
# of facilities	4	2	2	2	0	0	2

Mean: 1 15 public shows per week

Of the 12 facilities, 1 does not have any public programming; of the remaining 11, 10 or 91% tape some part or all of their public shows.

BUDGETS

Annual budget (X 1000)

	15-25	26-35	36-45	46-55	56-65	66-75	76-85	greater than 85
# facilities	6	1	1	0	1	0	1	2

Mean annual budget $46,216
Standard Deviation $34,736

SALARIES OF FULL TIME STAFF

DIRECTORS OR ADMINISTRATIVE HEADS

SALARY	10,500-12,500	12,501-14-500	14,501-16,500	16,501-18,500	greater than 18,500
# facilities	2	4	3	2	1

Mean Salary: $15,025
Standard Deviation: $2,793

ASSISTANTS (or next highest level)

SALARY	6,500-8,500	8,501-10-500	10,501-12,500	12,501-14,500	greater than 14,500
# facilities	3	1	0	3	1

Mean Salary: $10,655
Standard Deviation: $3,802

NEXT HIGHEST ASSISTANT

SALARY	6,000-8,000	8,001-10,000	10,001-12,000	12,001-14,000	greater than 14,000
# facilities	2	1	0	1	1

Mean Salary: $10,000