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Vol.10 No.3 Third Quarter, 1981
Delegates attending the 7th International Planetarium Directors' Conference in Calcutta, India, on January 1, 1981

see page 3
On January 1, 1981 the International Planetarium Directors Conference, meeting in Calcutta, India, unanimously adopted a resolution proposed by the International Planetarium Society to “formally open communications with the IPDC by asking the IPDC to select a representative to whom news and publications from IPS can be sent, and from whom news of the IPDC can be received.”

This photograph of the participants at the Calcutta conference is provided by Ing. Gabriel R. Munoz B. Director of the Planetarium of the city of Morelia, Mexico, Calzada Ventura Puenteic Ticateme. At the Calcutta meeting Sr. Munoz was elected as the IPDC representative to IPS.

Dr. Joseph M. Chamberlain, President of the IPDC writes that it will have its next conference in West Germany (Stuttgart, Hamburg, Berlin) in August 1984; in the Soviet Union in August 1987; and in Morelia, Mexico in 1990.

DELEGATES ATTENDING THE 7th INTERNATIONAL PLANETARIUM DIRECTORS’ CONFERENCE

In the Picture

1. Dr. J.M. Chamberlain, President, Adler Planetarium, Chicago, USA.
2. Mrs. Paula Chamberlain.
3. Dr. Hermann Mucke, Director, Ucania Observatory and Vienna Planetarium, Austria.
5. Dr. A. Kunert, Director, Mit Zeiss Planetarium, Berlin, East Germany.
6. Professor Antonio Cornejo, Director, Buenos Aires Planetarium, Argentia.
7. Dr. Hans-Ulrich Keller, Director, Planetarium, Stuttgart, West Germany.
8. Dr. E. Ubelacker, Director, Hamburg Planetarium, Hamburg, West Germany.
9. Dr. Tomoto Sato, Director, Nagoya Science Museum and Planetarium, Nagoya, Japan.
10. Takasi Yamada.
11. Mrs. Seiko Sato.
12. Dr. Terence P. Murtagh, Director, Armagh Planetarium, Northern Ireland.
13. Dr. Donald S. Hall, Director, Strasenburgh Planetarium, Rochester, New York, USA.
14. Mrs. Judy Hall.
15. Miss Elizabeth Hall.
16. Mr. Schueler, Carl Zeiss Jena, East Germany.
17. Mr. Koehler.
18. Mr. Duedwig.
19. Dr. Nibondh Sabramanian, Director, Bangkok Planetarium, Bangkok, Thailand.
20. Dr. K. Portsevski, Director, Moscow Planetarium, Moscow, USSR.
22. Dr. Venkatavardhan, Director, Nehru Planetarium, Bombay, India.
23. Dr. Kulkarni, Baroda Planetarium, Baroda, India.
24. Mr. R. Sabramanian, Director, Birla Planetarium, Calcutta, India.
25. Mr. Rosjidi Imam.
27. Mrs. Elvia Munoz.

Continued on page 12
COMMON ERRORS IN "STAR OF BETHLEHEM" PLANETARIUM SHOWS

John Mosley
Program Supervisor
Griffith Observatory
Los Angeles, California

Since the 1940's most of the planetariums in the western world have presented a show on the Star of Bethlehem in what has become one of the newer Christmas customs. As the first Christmas shows are older than most planetariums (and most planetarians!) we have learned from each other and from those who went first, and for the most part we all present shows that are quite similar and that have not changed dramatically in at least a generation. (How did YOU learn to give your first Christmas show?)

Unfortunately we have copied each others' errors along with everything else, and these errors have been repeated in lectures and in print to where they have become planetarium folklore and myth. Yet despite their time-honored status of respectability, they are still errors, and if we represent ourselves as trusted sources of information we have an obligation to be as accurate as possible, even on minor points.

Each of the following eleven statements often heard in planetarium shows is either factually incorrect or is misleading and requires qualification.

1. KEPLER SUGGESTED THAT A TRIPLE CONJUNCTION OF JUPITER AND SATURN WAS THE STAR OF BETHLEHEM.

Although Kepler was the first person to calculate that the triple conjunction had occurred in 7 B.C., he actually suggested something quite different.

In December, 1603, Kepler watched a conjunction of Jupiter and Saturn that took place in Sagittarius in the morning sky. (NOTE: this was a SINGLE conjunction.) The conjunction was astronomically important because it took place in a constellation that was one of the points of the Fiery Trigon, and was to be followed the next autumn by a triangular grouping of Mars, Jupiter, and Saturn—a fiery triangle in the Fiery Trigon. As an omen this was surpassed only by a comet, and many astrologers in 1603 predicted that a comet would be produced by the planets' close proximity late in 1604.

In Kepler's day the location of a conjunction was as important as the conjunction itself. The 12 signs of the zodiac were divided into four trigons, each made of three associated and equally-spaced constellations. Pisces, Cancer, and Scorpio were the Watery Trigon while Sagittarius, Aries, and Leo were the Fiery Trigon. Jupiter-Saturn conjunctions occur at 20-year intervals and 117 degrees apart, and shift westward (clockwise) through the signs of a given trigon, remaining within the signs of one trigon for almost 200 years and then shifting into the adjacent trigon. After nearly 800 years (actually 794.4) they begin a new cycle back at nearly their original position as measured with respect to the vernal equinox. The conjunction that Kepler watched had occurred in essentially the same position 800 years before and 800 years before that; Kepler believed the event had happened only eight times since the creation of the world.

The massing of Mars, Jupiter, and Saturn in 1604 was awaited with anticipation. "Some watched to correct their ephemerides, some for the sake of pleasure, some because of the rarity of the occasion, some to verify their predictions, and others, indeed, to see if there would be a comet as had been expressly predicted by the astrology of the Arabs," Kepler wrote (Kepleri Opera Omnia vol. II, p. 617, as quoted by Burke-Gaffney). Mars came first into conjunction with Saturn, on September 26, and then with Jupiter on October 9. Although Kepler missed this last event because of clouds, others in Europe saw the two planets and noted nothing amiss.

On October 10 a new star, as bright as Jupiter, was spotted essentially between Jupiter and Saturn, which themselves were only 9 degrees apart. Kepler observed it carefully until it faded into the sun's glare the following year, and later wrote a book De Stella Nova in Pede Serpentarii (About the New Star in the Serpent's Foot).

While writing this book, Kepler came across a work by Laurence Suwyla of Poland that argued that Christ was born in 4 B.C. Kepler immediately noticed that this was shortly after a triple conjunction that he calculated had occurred in 7 B.C., and wondered if there was a connection. In 1614 he published his conclusions: the triple conjunction of 7 B.C. was followed by a massing of Mars, Jupiter, and Saturn in 6 B.C., and just as the conjunction and massing of 1603–4 had produced a new star, so the events of 7–6 B.C. had produced a miraculous nova, and THAT NOVA was the Star of Bethlehem. The biblical triple conjunction took place in Pisces, but the massing that followed took place in Aries—one of the fiery signs—just as the massing of 1604 had also taken place in a fiery sign.

Kepler believed that the star over Bethlehem was a nova placed there specifically to alert and guide the magi. He wrote, "I do not doubt but that God would have condescended to cater to the credulity of the Chaldeans."

Today the supposed nova of 6 B.C. is often forgotten and it is stated that Kepler identified the triple conjunction with the Star of Bethlehem. This incorrect statement dates to the early 19th century when Bishop Munter of Zealand, Denmark, who apparently did not know of Kepler's work or of the nova of 1604, independently suggested that the TRIPLE CONJUNCTION alone was the Star. He wrote that since the two planets were only one degree apart, weak eyes would have made them out as a single star—clearly a false impression. In a popular chronological handbook published a few years later, Ludwig Ideler, who did not know of Kepler, incorrectly attributed Munter's hypothesis to Kepler. Munter's book was widely read while Kepler's was not, and the error became entrenched in the literature.

2. WHEN DETERMINING THE DATE OF THE BIRTH OF CHRIST, DIONYSIUS EXIGUUS FORGOT THAT CAESAR AUGUSTUS HAD RULED UNDER THE NAME OF OCTAVIAN FOR FOUR YEARS, AND THUS MADE A FOUR-YEAR ERROR.
Dionysius Exiguus (Dennis the Little) was a Scythian monk and prominent scholar who lived in Rome and who had access to the state and church archives, including many records now lost to us. It is true that Julius Caesar's grandnephew Octavian ruled as part of a triumvirate under his own name for four years, and was not proclaimed emperor Caesar Augustus until after he defeated the combined forces of Antony and Cleopatra at the naval battle of Actium in September, 31 B.C., but this was common knowledge. Schoolboys were expected to know the story, and a prominent historian working in Rome would not have made such a simple blunder.

Dionysius carefully selected the year we would call 1 B.C. for the birth of Christ, and set the date at December 25th as was customary in his time, and commenced the Christian Era with January 1, 1 A.D. (six days later) to agree with the start of the ordinary Roman triumvirate under his own name for four years, and was not proclaimed emperor Caesar Augustus until after he had defeated the combined forces of Antony and Cleopatra at the naval battle of Actium in September, 31 B.C., but this was common knowledge. Schoolboys were expected to know the story, and a prominent historian working in Rome would not have made such a simple blunder.

3. WHEN CHRIST WAS BORN, THE OLD ROMAN CALENDAR WAS IN USE, AND YEARS WERE COUNTED FROM THE FOUNDING OF ROME (AUC).

Although the Romans had devised a system of counting years consecutively beginning with the founding of Rome, in practice this system was seldom used. It would have been nice if they had because then the problems that occupy so much of historians' time would be that much simpler.

The date of the founding of Rome was not known and various dates were given by different authorities. The most commonly accepted date was April 21 of the third year of the 6th Olympiads (753 B.C.) as calculated by the antiquarian Varro (116—27 B.C.). In the Varronian Era, 753 B.C. is set to AUC 1. "AUC" is from "ab urbe condita," or "from the founding of the city."

The most common way of designating the year was by referring to the two consuls who were in office that year. For example, "In the following year, when Quintus Fabius and Lucius Fulvius were consuls . . ." The "Annales Maximi," compiled in 130 B.C., was one of the earliest lists of consuls and was incorporated into later longer lists. The other common way was to refer to the year of the king or emperor, as "In the ninth year of Hadrian . . .".

By the time of Dionysius Exiguus, a more modern system was in use, and years were counted consecutively from September 17, 284 A.D., when Diocletian was proclaimed emperor by his troops at Chalcedon. This was the "Era of Martyrs," or "era martyrum," and the years were "Anno Diocletiani." The system was modern in that the count did not begin again with each new emperor. Each year began on August 29th, the Egyptian New Year's Day Thoth 1 (for example, Anno Diocletiani 100 ran from August 29, 383 to August 28, 384).

While preparing new Easter tables in 525, Dionysius broke with tradition and began the system now in use. He wrote, "We have been unwilling to connect our cycle with the name of an impious persecutor, but have chosen rather to note the years from the incarnation of our Lord Jesus Christ." Dionysius set A.D. 1 (from "ab incarnatione Domini") equal to 754 AUC, according to reckoning current in his time. His new Christian calendar was not immediately accepted, and the Diocletian calendar continued in use until the 8th century.

In short, the Romans knew of a counting system that began with the founding of Rome in AUC 1, but unfortunately did not use this system to any significant extent, and the true situation is much more complex.

4. THE WORD FOR "STAR" USED IN MATTHEW IS THE SAME IN THE SINGULAR AND PLURAL FORMS, LIKE "FISH," AND SO THE "STAR" COULD HAVE BEEN A SINGLE OBJECT OR A GROUP OF OBJECTS.

The New Testament Greek work for star is "aster" (ἀστήρ) and the word for stars is "asteres" (ἀστερεῖς), and the two are clearly distinct. The word "star" occurs four times in Matthew, and each time it is singular.

Less clear is why Matthew, if he did want to refer to a group of objects, either planets or stars, did not use the word "astron," (ἀστρον), which means constellation. For that matter he could have used the words for planet "planes aster" (πλανήτισ ἀστήρ)—our word "planet" comes from the plural form "planetaes" (πλανήτες). He did not, perhaps because he preferred to use the more traditional and familiar "aster" which appears 24 times in the Old Testament, instead of "astron" or "planets aster" which do not appear in the Old Testament at all. Although the word Matthew used means a single star in the literal sense, we cannot exclude the possibility that he was deferring to poetry or drama.

In current planetarium shows at the Griffith Observatory we tentatively identify Matthew's "star" with the planet Jupiter, as Jupiter came into close conjunction with Venus twice and with Regulus three times in a 10-month period near the time of the nativity.

In any case, the Greek word for star is not the same in its singular and plural forms.

5. "WE SAW HIS STAR IN THE EAST" CAN BE TRANSLATED TO MEAN EITHER "WE SAW HIS STAR WHILE WE WERE IN THE EAST," OR "WE SAW HIS STAR (AS IT ROSE) IN THE EASTERN SKY," AND IS AMBIGUOUS.

The Authorized King James version of this passage in Matthew reads "there came wise men from the east to Jerusalem saying, Where is he that is born King of the Jews? for we have seen his star in the east, and are come to worship him." And later, "they departed, and, lo, the star which they saw in the east . . ." This has been interpreted to mean EITHER that the star was in the eastern part of the sky OR that the wise men were in the eastern part of the world when they saw it, but the actual situation is not so ambiguous. The Greek phrase, "en te anatole" simply means "as it rose" or "at its rising" which of course is always in the eastern sky, and does not refer to the location of the observer. Some authors interpret the phrase to mean that the magi observed the star's pre-dawn heliacal rising with the sun, and although this may be the case it is an assumption not contained in "en te anatole." The error is the fault of mistranslation by the committee of scholars working under the sponsorship of King James of England, and has been corrected in the New English Bible to read "We observed the rising of His star . . ." and "the star which they had seen at its rising . . .".

Both translations of the Bible agree that the magi came from the east of Jerusalem, probably from Persia.

6. JOSEPH AND MARY WENT TO BETHLEHEM TO PAY THEIR TAXES, ACCORDING TO AN INSCRIPTION FOUND ON A TEMPLE IN TURKEY, THIS WAS PROBABLY THE GENERAL ROMAN TAX OF 8 B.C.

The "tax" that sent Joseph and Mary to Bethlehem is often cited as the major clue in establishing the earliest date for the birth of Christ, and is generally linked with the universal taxation of 8 B.C. This is incorrect for several reasons.
The error dates to the incorrect translation of Luke’s word “apographe” as “tax” in the King James version. The correct word for tax is “apotimesis,” while “apographe” is properly translated as registration or enrollment and does not imply the payment of goods or money. Contrast the King James version: “And it came to pass in those days, that there went out a decree from Caesar Augustus, that all the world should be taxed. (And this taxing was first made when Cyrenius was governor of Syria.)” with the corrected New English version: “In those days a decree was issued by Emperor Augustus for a general registration throughout the Roman world. This was the first registration of its kind; and it took place when Quirinius was governor of Syria.”

There was a tax in 8 B.C. (and others in 28 B.C. and 14 A.D.) as is recorded on the walls of the Monumentum Ancryanum at the Temple Augusteum in Ankara, Turkey, but this tax cannot be the registration described by Luke for several reasons. That tax was levied specifically on Roman citizens who lived within the empire and who then normally paid at their place of residence or birth. Joseph and Mary were not citizens and were exempt, and in any case would not have had to travel to the place where their family originated. Nor in a general taxation would Mary have had to accompany her husband. And Herod’s semi-autonomous kingdom was outside the empire proper until 6 A.D., and any tax levied before then would have been ordered and collected by Herod under his own rules.

The correct identity of Luke’s registration has been a long-standing puzzle to historians. Recently Dr. Ernest Martin suggested that it was an oath of allegiance made on the occasion of Augustus’ Silver Jubilee in 2 B.C. (see Chapter 5 of the second edition of his book). On February 5 of that year, Augustus was awarded the title “Pater Patriae,” Father of the Country, in a year of celebrations that commemorated the 750th anniversary of the legendary founding of Rome as well as Augustus’ 25th year of rule. In the autograph account of his own life, the Res Gestae, Augustus wrote: “While I was administering my 13th consulate the senate and the equestrian order and the entire Roman people gave me the title Father of My County.” The 5th century historian Orosius told how in that same year Augustus “ordered that a census be taken of each province everywhere and that all men be enrolled. This is the earliest and most famous public acknowledgement which marked Caesar as the first of all men and the Romans as lords of the world . . . in this one name of Caesar all the peoples of the great nations took oath, and at the same time, through the participation in the census, were made a part of one society.” Josephus relates that “therefore the whole Jewish nation took an oath to be faithful to Caesar and the interests of the king (Herod) . . . .” An inscription from Paphlagonia in Asia Minor from 3 B.C. records an oath “taken by the inhabitants of Paphlagonia and the Roman businessmen dwelling among them . . . The same oath was sworn also by all the people in the land at the altars of Augustus . . . .” Note that the common thread here is an OATH OF ALLEGIANCE required of ALL THE PEOPLE, citizen and noncitizen alike, both in the empire and its provinces, for the purpose of establishing fealty. This oath was either ordered by Augustus at the time of his jubilee and completed that year (2 B.C.), or was conducted during the year prior to the jubilee (3 B.C.) and the results presented to him as part of the ceremonies.

If Luke’s registration was Augustus’ loyalty oath we can understand why both Joseph and Mary went specifically to Bethlehem. We are told that Joseph, being of the house and lineage of David, went to the city of David (Bethlehem), while everyone else went into his own city. As a descendent of David he was obliged to return to Bethlehem along with other claimants to the throne of Israel; under Jewish law the right to kingship could pass to Mary’s descendents and so she had to accompany her husband.

Planetarians who like to delve into the historical clues used to date the nativity will find that the oath of allegiance to Augustus on his Silver Jubilee is a more dramatic story than the one about taxes.

7. THE “STAR” WAS A TRIPLE CONJUNCTION OF MARS, JUPITER, AND SATURN. THIS CONJUNCTION, HOWEVER, COULD NOT BE SEEN BECAUSE THE PLANETS WERE TOO CLOSE TO THE SUN.

This statement contains two separate errors. A triple conjunction is, by definition, three consecutive conjunctions between the same two planets (or a planet and a star) and happens when the nearer of the two goes through its retrograde loop in front of the more distant. Three planets cannot be said to be in conjuction unless they have precisely the same longitude (or right ascension), and this never happens. The grouping of Mars, Jupiter, and Saturn is more properly called a massing of the planets. There was a triple conjunction of Jupiter and Saturn in 7 B.C. followed by a massing of Mars, Jupiter, and Saturn in 6 B.C.

The massing was clearly visible. Mars and Saturn were in conjunction on February 20, 6 B.C. when the longitudes of Mars, Jupiter, Saturn, and the sun were 351.2, 358.6, 352.0, and 329.8 degrees respectively as interpolated from Tuckerman’s Planetary, Lunar, and Solar Positions. (Mars and Saturn were at equal longitude 12 hours later but had set by then; the numbers given here are for 7:00 p.m., Babylon time.) The sun was 21 degrees west of the westernmost two planets and 29 degrees west of Jupiter. All three planets were still visible above the horizon AFTER the end of evening twilight. Robert Victor of Abrams Planetarium clearly saw the Mars-Saturn conjunction of February 20, 1966, even though these planets were much closer to the sun than in 6 B.C. and were observed from a higher latitude than the Near East.

8. A TRIPLE CONJUNCTION OF JUPITER AND SATURN OCCURS ON THE AVERAGE OF ONCE EVERY 120 (OR 139) YEARS.

SINGLE conjunctions of Jupiter and Saturn occur regularly once every 20 years, but TRIPLE conjunctions are not periodic.

Each year Jupiter advances about 30 degrees along its orbit and Saturn advances 12 as seen from the sun, and Jupiter gains on Saturn by 18 degrees. Every 20 years (actually 19.8592) Jupiter overtakes Saturn and there is a conjunction, but this number is an average because we must take into account the position of the earth and eccentricity of the orbits of the three planets. This conjunction is triple if the earth passes both Jupiter and Saturn within about 40 hours of each other—then Jupiter’s motion carries it retrograde back past Saturn a second time and then forward again for a third time. These three conjunctions occur within a seven-month period.
10. **CHRIST WAS BORN IN THE SPRING BECAUSE THAT IS THE ONLY TIME OF THE YEAR WHEN SHEPHERDS ARE OUT IN THE FIELDS WATCHING THEIR SHEEP.**

At first this might seem a useful clue for limiting the time of year when Christ was born, but it is probably of no real value. Shepherds are in the fields with their sheep during most of the year except the rainy winter months when nighttime temperatures average in the 40s and snow is not uncommon. Even so, there is no guarantee that the shepherds were not out in inclement weather if there was reason for it. And some sheep, the “wilderness flocks,” remained out all year long, while sheep used in temple sacrifices were watched over all the time.

In short, the shepherds give us no reliable information about the time of the nativity.

11. **EARLY CHRISTIANS CELEBRATED CHRIST’S BIRTH ON DECEMBER 25 BECAUSE THIS IS THE DATE OF THE ROMAN SATURNALIA AND THE CHRISTIANS HOPED TO GO UNNOTICED WHILE THE ROMAN PAGANS WERE OCCUPIED WITH THEIR OWN ROWDY CELEBRATIONS.**

December 25th is an interesting date that has astronomical connections, but it is NOT the date of the Saturnalia.

The Saturnalia was originally a harvest festival roughly equivalent to our American Thanksgiving. It began with a public sacrifice at the temple of Saturn and was followed by feasting. Although originally a one-day festival celebrated on December 17 and followed by two days of general holiday, it grew to eventually encompass seven days (Augustus limited it to three for the sake of business, but it grew back to five). It was a popular holiday when gifts were exchanged, schools closed, and slaves were given special considerations. At no time, however, did the holiday extend to include the 25th.

December 25th became a major holiday in the Roman world in 275 A.D. when Emperor Aurelian proclaimed the date as “Dies Natalis Invicti” or “Dies Natalis Solis Invicti”—the Birthday of the Unconquerable Sun—and with the followers of Mithra dedicated a temple to the sun in Roman’s Campus Martius. Christmas originated at a time when the sun cult was particularly strong in Rome, and traces many of its customs to sun worship.

The earliest Christians had no reason to keep a low profile on the 25th because it was not until Aurelian that meaningful celebrations took place on that date. When Christmas began to be celebrated in the 4th century Christianity was legal and there was no reason to hide. Avoiding the Saturnalia would have been comparable to a modern religious sect avoiding Thanksgiving. When Christianity finally became the dominant religion in the empire, older pagan holidays and ancient customs were given new meanings. An obvious example is Easter which is celebrated with rabbits and eggs—springtime symbols of fertility. Early church fathers found it impossible to stamp out popular pagan practices and compromised by Christianizing them. Mexico provides interesting examples of how the native Indian festivals acquired a thin veneer of Catholicism. Christmas is celebrated at the time it is to give Christian meaning to previously existing pagan celebrations.
The exact date is important astronomically. December 25th is the date of the winter solstice in the Julian calendar (January 6th is the date of the solstice in the Egyptian calendar, still a day of celebration in many countries). The Julian calendar lost one day in 128 years, and Christmas had slipped to December 22nd by the time of the Council of Nicaea in 325 A.D. By 1582 it had slipped to December 12th. When Pope Gregory reformed the calendar he restored the date of the solstice to the time of the Council of Nicaea, the first great Christian gathering, rather than to the time of the birth of Christ or to the time of the founding of the Julian calendar. That is why the holiday remains on the 25th—the day of the sun’s rebirth as proclaimed by Aurelian—although the solstice now falls on the 22nd.

In our annual Christmas show at the Griffith Observatory we like to explore the astronomical and pre-Christian origins of many modern Christmas customs.

SELECTED REFERENCES

SLIDE REGISTRATION WITHOUT TEARS
Bob Farrell
Vanderbilt Planetarium
Centerport, Long Island, NY 11721

The following is a simple method of photographing a series of graphics which will dissolve convincingly. By dissolve, I mean the precise registration of each projected slide to the others in a series of slides. The series may be used for animation, picture buildup by parts, picture breakdown by parts, or any other imaginative sequence one can dream up.

Two items lay at the heart of this technique. The first is the Kodak Ektographic projector used as a camera. The second is a pin-registered slide mount made by Wess Plastics.

The set-up consists of an Ektographic projector loaded with Wess mounts in the carousel tray. Each mount holds a piece of unexposed graphic arts film. Artwork, books, or whatever is to be copied is secured on a holding fixture. At this point, we should be aware that the projector isn’t light-tight and the room should be considered a darkroom.

In the best of all worlds, slides will project in perfect registration if:
1. the artwork is perfectly registered.
2. the camera is perfectly registered.
3. the transparency is perfectly registered in the slide mount; and
4. the projectors used for display are perfectly registered.

The use of Wess mounts solves item 3 quite satisfactorily and cheaper than the Kodak metal mount assembly. Still, the greatest savings is in labor costs. Though this system has limited application (a pin-registered camera is the full blown approach), it brings us closer to the goal of standardizing our techniques.


Wess Plastic
50 Schmitt Blvd.
Farmingdale, NY 11735
516–293–8994

Eastman Kodak Company
343 State Street
Rochester, NY 14650

H. A. Metzgar
157 Chambers Street
New York, NY 10007
212–267–4190

W. T. I. Corporation
Multi-Image Developments
27324 Camino Capistrano, Suite 181
Laguna Niguel, CA 92677
714–831–0111

Equipment
1. Kodak Ektographic E2 projector or equivalent
2. Wess film trimming unit
3. Gralab darkroom timer or equivalent
4. Light fixture/red lamp
5. Single slide projector or photoflash unit
6. Bulk film loader

Supplies
1. Wess mounts #2, high heat/anti-Newton ring glass
2. Kodak Kodalith film 6556, type 3, 35mm, 100’ roll
3. Kodak high speed duplicating film 2575, spec 653, 100’ roll*
4. Kodalith fine line developer

*available from graphic arts dealers only.
I know that this has nothing to do with my column, but today I watched the successful landing of the Space Shuttle, Columbia. For the first time, in a long time, I felt "excitement" about the United States' Space Program—the same kind of excitement I felt a decade ago with the lunar landings. I hope that the Space Shuttle will generate the kind of public interest in the planetarium in the coming years that Apollo did for us in the 70's. As more and more of us come under the "budget crunch" we can use all the good publicity and visitation we can get!

Many of you are sending me material to review. Good! Keep it up. If you do not see it in print right away, don't worry. I try to write in a first-come, first-served basis. Be patient, it will make it in print.

Astronomical Data Service of 3922 Leisure Lane, Colorado Springs, Colorado 80917, sent me a nice pack of things to review. First is their new Starwatcher's Chart of the Celestial Sphere. It is 24" x 34" and black on white. The starfield is computer generated and contains more than 1,100 stars. However, the chart actually contains three charts, the North Celestial Polar Region, the South Celestial Polar Region, and the Celestial Equatorial Region. The price of this chart is only $8, and I think it is worth the price. Other publications by this company include: Local Planet Visibility Report—computed for purchaser's own latitude, longitude, and time zone; Sunlight Summary—also computed for purchaser; Comparative Ephemeris and a Special Report to Celestron Telescope Owners. The prices on these items are: $13; $16; $6; and $8 respectively.

Science Graphics, formerly Norton Scientific, has just published their 1981-82 Catalog. Now into Geology as well as Astronomy, the quality of these slides just keeps getting better. The catalog is divided into major areas such as Solar System Astronomy, Stellar and Galactic Astronomy, and Geology. Under each major area are the Series which are divided into sets. The Earth Series, Lunar and Solar Series, Solar System and Planetary Structure Series and the Constellation Series make up Solar System Astronomy. Stellar and Galactic Astronomy is made up of seven sets. Geology is divided up into the Mineral Series, Rocks and Rock Structure Series, Effects of Water Series, Landform Series, Structural Geology Series, Planets: Origin and Evolution Series, Earth From Space Series, and the Planetary Geology Series. For more information and prices contact them at Post Office Box 17871, Tucson, Arizona 85731.

Beltone Electronics Corporation, 4210 West Victory Street, Chicago, Illinois 60646, has just released information about their new Wireless Slide-a-matic. It can only be used with Kodak Carousel or Ektographic slide projectors but can provide the user remote operation of the projector up to 300 feet. The literature is not clear if it only advances or is a complete operative device. The price is $119.95, and if you wish more information, contact them.

Sky-Scan, Inc. has just released their new catalog # 106. And, of course, a new price list. New for '81 includes a 15:1 zoom lens, Rotating Galaxy-Black Hole Projector, Rotating Saturn Projector, Bolide Projector, three Moire Projectors, X-Y Axis Mirror Slew, and for the first time Special Effects Sounds and Music, Panorama Scenes and four full-produced star shows. The list could go on and on so I suggest you write them at 7350 Dryer Road, Victor, NY 14564.

"Out of This World Lithographic Prints" by Joan and Joe O'Connell can provide you with two outstanding prints of the planet Saturn as seen by Voyager I. They do sell in large orders if you would like them in your bookstore. You can get more information by writing them at 2136 South Yukon Street, Denver, CO 80227.

Another slide company is Projected Learning Programs, Inc. They have also released their 1981–82 catalog of audio-visual material. Materials include slides, filmstrips, videotapes, transparencies, and film loops. The material covers such areas as Biology, Zoology, Botany, Environmental Science, Earth Science, and Physics. I have not had the opportunity to see any of these graphics, but the illustrations in the catalog look good. You may obtain a catalog by writing them at Post Office Box 11857, Reno, Nevada 89510.

If you have something that you would like me to review, be it graphics or projectors or whatever, don't hesitate to contact me by phone or mail. I will work it in as soon as I can. Also, coming soon, "The Micro-Planetarium"!
One of the most popular questions at the planetarium this year concerns the line-up of the planets in 1982. Quite a bit has been written about this subject and its consequences, including a widely-read paperback predicting earthquakes and other catastrophies (Gribben, 1976). But little real information is given in these writings telling just how close the alignment will be.

I decided to tackle this problem working toward two goals—to determine the arrangements of the planets throughout 1982 and to display the results in a useful and readable form.

The heliocentric longitude of each of the planets was calculated for all of 1982 on a Hewlitt Packard 9835 computer. The method used (Duffet-Smith, 1979) gives an error in the calculated longitude of generally less than one degree. The greatest error occurs for Mercury near perihelion, and even then the calculated values are within 2–3 degrees. The results of these calculations were then displayed graphically on the computer's plotter, as heliocentric longitude vs. date.

Figure 1 shows the results for the outer three planets. These planets move so slowly that their longitudes barely change throughout the year. Because Neptune and Pluto are approximately 60 degrees apart, with Uranus in between, they establish a lower limit on the alignment. Therefore, the planets must be spread over at least 60 degrees.

In Figure 2, Jupiter and Saturn are added. This changes the lower limit very little, since Jupiter is between Neptune and Pluto, and Saturn is just outside until the end of the year. The lower limit is now about 65 degrees.

In Figure 3, Mars and Earth are added. Mars is within this 65 degree band from mid-April until mid-August, while Earth is there from mid-April to mid-June.
In Figure 4, the last two planets, Venus and Mercury, are added. Mercury is also in this 65 degree band from mid-May until early June. Venus, however, passes through too early.

If we omit Venus, all the planets are in the 65 degree band from mid-May to early June. If we include Venus, the best arrangement during this period is on May 15. The spread would then be 105°, with Mercury and Venus establishing the limits. (See Table 1)

<table>
<thead>
<tr>
<th>Planet</th>
<th>Heliocentric Longitude March 10</th>
<th>May 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>264°</td>
<td>199</td>
</tr>
<tr>
<td>Venus</td>
<td>199</td>
<td>304</td>
</tr>
<tr>
<td>Earth</td>
<td>169</td>
<td>234</td>
</tr>
<tr>
<td>Mars</td>
<td>181</td>
<td>211</td>
</tr>
<tr>
<td>Jupiter</td>
<td>212</td>
<td>217</td>
</tr>
<tr>
<td>Saturn</td>
<td>198</td>
<td>200</td>
</tr>
<tr>
<td>Uranus</td>
<td>242</td>
<td>242</td>
</tr>
<tr>
<td>Neptune</td>
<td>265</td>
<td>265</td>
</tr>
<tr>
<td>Pluto</td>
<td>205</td>
<td>205</td>
</tr>
</tbody>
</table>

The alignment, then, is not quite as exciting as some people have indicated, although they are, indeed, all on the same side of the sun during March of 1982.

These diagrams can serve other useful functions, too. The slope of a line is related to the speed of the planet. The diagram clearly shows the large differences in speeds of the planets and that the inner planets do, indeed, move the fastest. Also, if the planets followed perfectly circular orbits, the lines would be straight. Laying a straight edge on each line shows they are not straight and that the planets do vary their speed. (For the outer planets one year is too small a section of an orbit to show much deviation from straight. If the horizontal scale is condensed to show 100 years, rather than 1 year, the nonlinear character is readily visible, especially for Pluto.) Mercury’s orbit is, of course, so non-circular that its line is obviously not straight. Venus’ orbit, however, is so close to circular that its line is essentially straight.

I hope eventually to try extending these programs to look ahead for the next “line-up of the Planets.”

References
I watched Dave Bell’s creative musical talent, combined with his keen sense of timing and what sounds “right” make scripts come to life in the sound studio.

Sharing in, and observing the production of new shows was not the only source of new ideas however. Perhaps my biggest surprise came when I sat in on the several school shows offered by the Strasenburgh. Having always worked under a dome that restricted groups to sixty or fewer, I felt that, for instructional purposes, smaller group size helped ensure a more personal, and therefore more effective mode of communication. This preconception evaporated in the face of the superb shows I saw here. Fran Biddy’s version of “Earth, Sun, and Moon” was especially effective. He has this program down pat, yet it flowed in a delightfully spontaneous way. Fran elicited student response, and he got it with enthusiasm. At just the right spots, Fran, from the center of the room, was able to call up short taped and computerized show segments that dramatically illustrated the point at hand. Then it was back to live action. Two hundred kids ate it up with hardly a restless shuffle during the entire show. This was large group instruction at its very best.

We’ve decided that even with smaller group size, carefully crafted programs, alternating taped-automated segments with live presentation will be far more effective than the free-form “spontaneous” format we’ve been employing at our facility for years.

Our public shows also will show the effects of my Strasenburgh semester. Probably the most obvious improvement will be the elimination of the “format” around projected images. Opaquing, masking, and double masking, learned and practiced in Vic Costanzo’s art studio will be employed by our students to prepare slides for their presentations.

Techniques and ideas freely shared by Carl Dziedziech and his technical crew will add motion, realism, and excitement to our shows, as we gradually build a variety of Strasenburgh-inspired special effects projectors.

Intangibles often turn out to be the best part of any experience. Just being with the Strasenburgh team for a semester was an experience in itself. Being surrounded by a group of very talented individuals who are dedicated to “the planetarium thing” recharged my batteries, depleted by years of “going it alone” in the typical small planetarium. It felt great!

Business and industry use promotion and transfer to help their personnel grow professionally. In the planetarium field, we’re pretty much on our own. If we don’t change employers from time to time (and that’s not desirable for most of us), “well-rounded” is whatever we become within the confines of a single facility. We need to broaden our horizons.

There is much to be said for finding some way of spending an extended period of time working at another planetarium. Based on my experience, I heartily recommend it.

James Orgren, Director
Buffalo State Planetarium
State University College at Buffalo
1300 Elmwood Avenue
Buffalo, NY 14222
A 3-Month Star Chart
Dr. Robert J. Doyle
Frostburg State College Planetarium
Frostburg, Maryland 21532

I. Introduction
Despite the current emphasis on dramatic programs and special effects projectors, one of the main reasons why many people visit planetarium presentations is to acquire a simple acquaintance with the brighter stars and planets in the night sky. As is the custom in many planetaria, 10 or 15 minutes at the beginning or end of the program are devoted to featuring the current night sky and forthcoming celestial events. But when many of our patrons return home and try to sight the brighter stars and planets in their backyards, the memory fails them; stellar configurations and planetary groupings seen clearly on the dome seem to evaporate, often due to observing at the wrong time or direction. To provide a bridge from the planetarium sky to the real sky, some planetaria distribute evening star charts that their patrons can use to identify the brighter stars and planets. At the Vanderbilt Planetarium in Long Island, an oval shaped sky chart, resembling the view of a planisphere, is used. Another variation of the monthly chart is the clover sky map, which appears in Levitt and Marshall’s Star Maps for Beginners. But these standard sky charts have a fundamental limitation—they can be used for only a month or two and portray the star positions for only one time during a night. Plainly a new kind of chart is needed—one that can portray apparent sky motion over a few hours or months, as well as a chart that can be duplicated easily (unlike a planisphere).

This paper will present the basic visibility characteristics required of all full sky charts and a successful chart design that represents star motion over a three-month period.

II. Required Visibility Characteristics for Full Sky Charts
The formulae relating the hour angle H, declination δ, azimuth A and altitude a of the sky objects are:

\[
\sin a = \sin \delta \sin \phi + \cos \delta \cos \phi \cos H
\]

\[
\cos A = \sin \delta - \sin \phi \sin a
\]

\[
\cos \phi \cos a
\]

where \( \phi \) is the observer’s latitude

For the case of rising or setting (the visibility limits), \( a = 0^\circ \), so the above equations simplify to:

\[
\cos H = \tan \tan \phi
\]

\[
\cos \delta = \cos A \cos \phi
\]

For a given observing site, the first equation will show the maximum hour angle visible for a given declination. For example, consider \( \phi \) (latitude) \( = +40^\circ \)N. Then the corresponding declinations and maximum hour angles are given in the table below:

<table>
<thead>
<tr>
<th>Declination</th>
<th>+40°</th>
<th>+30°</th>
<th>+20°</th>
<th>+10°</th>
<th>0°</th>
<th>-10°</th>
<th>-20°</th>
<th>-30°</th>
<th>-40°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour Angle</td>
<td>8.99</td>
<td>7.93</td>
<td>7.19</td>
<td>6.56</td>
<td>6</td>
<td>5.43</td>
<td>4.81</td>
<td>4.07</td>
<td>3.01</td>
</tr>
</tbody>
</table>

The above table can be approximated crudely by the expression Max. Hour Angle \( = 6 + \delta/15 \).

Another useful problem is to consider at rising, what declinations correspond to a range of azimuths in the eastern sky. For example, consider a latitude of \( 40^\circ \)N. Then the corresponding azimuths (measured eastward from north) and declinations are given in the table below:

<table>
<thead>
<tr>
<th>Azimuth</th>
<th>22.5°</th>
<th>45°</th>
<th>67.5°</th>
<th>90°</th>
<th>112.5°</th>
<th>135°</th>
<th>157.5°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declination</td>
<td>45.1°</td>
<td>32.8°</td>
<td>17.0°</td>
<td>0°</td>
<td>-17.0°</td>
<td>-32.8°</td>
<td>-45.1°</td>
</tr>
</tbody>
</table>

III. Selection of Transformation Equations for Sky Chart
With a knowledge of the visibility limits of the sky, we can consider the form of sky chart that will show motion of the stars over a few hours rotation.

A. Northern Sky Charting
The circumpolar stars move in circles about the North Celestial Pole, so a circular representation of the northern sky is most natural. The author selected a scale of \( 1^\circ \) per mm and used the polar equations

\[
X \text{ (in mm)} = (90 - \delta) \cos (-HA) + \phi/10
\]

\[
Y \text{ (in mm)} = (90 - \delta) \cos (-HA) + \phi/10
\]

for all circumpolar and near circumpolar stars. By simply rotating the northern sky chart, the northern sky is faithfully represented as the hour of night and date change.

B. Mid-Sky Charting
If the northern sky equations are used for the equatorial stars and southern stars, there is considerable distortion of the star groups in the southern sky, a common fault of many planispheres. In the planispheres designed by David Chandler, this problem is overcome by using south polar projection (southern stars are plotted based on their distance from the south celestial pole).

Several different kinds of south polar projections were tried—the main consideration being a relatively undistorted view of the principal mid-latitude star groups such as the Great Square, Ophiuchus, and Orion. It was found that most realistic projections were obtained by using a modified Hour Angle HA’ such that

\[
HA’ = \text{Actual HA} \times \cos (\delta/2)/2
\]

To obtain continuity between the northern and mid-sky portions of the chart, the mid-sky transformations were modified accordingly. They are

\[
X \text{ (in mm)} = (90 + \delta) \cos (-HA’) + 18 + \phi/10
\]

\[
Y \text{ (in mm)} = (90 + \delta) \cos (-HA’) + 18 + \phi/10
\]

To allow plotting of a star’s position for observer’s latitude \( 40^\circ \)N on a standard \( 8\frac{1}{2}” \times 11” \) sheet, star of declination \( -40^\circ \) to \(-50^\circ \) were omitted.

Appendix A—The “Angel” 3-Month Evening Sky Chart
The accompanying sky chart is for the months of September, October, and November 1981 for latitude \( 40^\circ \)North. The local sidereal time used in the computation of the star positions is that of longitude 79°3/4W (the Cumberland, Maryland area), but the chart is generally useful for any observer near latitude \( 40^\circ \)N. All zero, first, second, and the brighter third magnitude stars down to declination \(-40^\circ \) were included. Star positions are those of the 1980 epoch taken from the R.A.S.C. Observer’s Handbook (1980).
"Angel" 3 Month Evening Sky Chart
for September, October & November 1980

Star chart has 2 sections
head portion shows northern sky
wing portion shows rest of sky

As time passes,
head portion must be rotated
and horizons on wing part change.

To use head (northern sky) portion
read below directions

1. Using Orientation Table,
2. Rotate head portion until
date and hour of night
find the letter(s) for your
3. Chart shows northern sky.
   these letter(s) on bottom.

Chart Design © R.J. Doyle, FSC Planetarium
Frostburg, MD 21532
To use wing portion of chart

1. Using Orientation Table, find the letter(s) for your date and time of night.
2. Tilt chart so appropriate arrow points downward-your horizons ind. by letter.

While star positions shown are for the Cumberland (MD) Tri-State area (~79°W long.), the chart is useful for any location near latitude 40°N.

Note: Constellations & star groups in caps while stars & planets in lower case.
"Angel" 3 Month Evening Sky Chart for September, October & November 1980

Star chart has 2 sections:
- Head portion shows northern sky
- Wing portion shows rest of sky

As time passes,
- Head portion must be rotated
- Horizons on wing part change.

To use head (northern sky) portion:
1. Using Orientation Table, find the letter(s) for your date and time of night.
2. Tilt chart so appropriate arrow points downward - your horizons in.
3. Using Orientation Table, find the letter(s) for your date and time of night.

While star positions shown are for the Cumberland (MD) Tri-State area (~79°W long), the chart is useful for any location near latitude 40°N.
Appendix B—Computation of Sidereal Time

For computation of the local sidereal time to an accuracy of one second, a complete account is given in Practical Astronomy With Your Calculator by Peter Duffett-Smith. These computations involve:

1. Counting the number of days in the year since January 0, 0.
2. Multiplying this integer by .065709.
3. Subtracting from this product a constant B peculiar to the year in question (for 1980, B = 17.411473).
4. Converting the current Greenwich mean time to hours, multiplying by 1.002743 and adding this product to the result from step 3.
5. To the result from step 4, add your longitude hours (will be - if you are west of Greenwich). The final number will be the local sidereal time in hours.

References

2. Josephus, Flavius, Jewish Antiquities, Book XVIII, Chapter 2, Section 1.
5. Ibid., XVI, 4, 5.
6. Ibid., XVII, 8, 1.
7. Ibid., XVI, 9, 3; XVI, 10, 8; XVI, 10, 9; XVI, 11, 1.
10. Ibid., XVI, 4, 5 (Shilleto).
11. Ibid., XVI, 4, 6
12. Ibid. (Shilleto).
13. Ibid., XVII 2, 4 (Shilleto).
15. Ibid. XVII, 4, 3; XVII, 5, 1; see also XVII, 1, 1, for Antipater's motives behind his conspiracy against Herod.
16. Ibid., XVIII, 4, 1.
17. Ibid., XVII, 5, 2.
18. Ibid., XVII, 5, 1; XVII, 5, 7; XVII, 7; XVII, 8, 1.
19. Ibid., XVII, 6, 4.
20. Ibid., XVII, 8, 3.
25. The star of God—Numbers 24:17; the star is fulfilled in the birth of the person, Jesus Christ—Matthew 2:2 and Revelation 22:16; and the star inspires us forever—Mark 16:2 and 2 Peter 1:19.

NOTE:
The Creative Corner page is being printed in the format of the Special Effects Handbook (soon to be published), so that you can xerox the page for insertion therein if you wish.

Pages from The Planetarian will be sequenced alphabetically so you may order them in future handbook indices.
X-Y SLEWING UNIT

To control image motion in both axis, the X-Y SLEWING UNIT works quite well. Unlike large exposed mirrors, the housing eliminates most of the extraneous glare that is associated with reflection projection. Although elliptical telescope mirrors are called for, by enlarging the top housing, square or rectangular ones can be substituted. If possible, use reversible variable speed motors on both axis. Be extra careful when centering the "lazy susan" so that the friction puck drive will operate smoothly.
In the fall of 1980, a spacecraft named Voyager made its closest approach to the most beautiful planet in our solar system, Saturn. At this time, Voyager sent back to Earth thousands of pictures of the planet, its rings, and its moons. Because these pictures were transmitted by digital slow scan television, each picture took over forty seconds to be received, line by line, at NASA's Jet Propulsion Laboratory in Pasadena, California. Meanwhile, hundreds of radio amateurs and short wave listeners turned on computers and carefully tuned their radios, waiting for the first glimpse of pictures from space. Wait a minute, pictures and radio? How can that be! To understand how it works, let us first take a look at television and its various forms.

When you look at something, anything, an object or printed text, your eyes see the entire image at once. Thus, the brain receives thousands of bits, or pieces of information simultaneously. The problem with sending a picture over a wire or by radio wave is that you can send only one value at any one instant. To send the entire picture requires either thousands of wires or more practically, thousands of “instants”! The easiest way to do this is by breaking down the picture into lines. A signal can then be sent out for each bit of picture information in each line, line after line. Each bit or signal then represents the brightness of a particular piece of the picture. To send a color picture a filter can be placed between the subject and the device, such as a TV camera, that will then convert the image into an electronic signal. The signal then represents how red, or blue, or green the subject is. Other filters can be used. The Voyagers carry ultra-violet and infra-red filters. (Kieran, 1978)

To break an image down into lines of information the image must be scanned. The scanner can be any one of four basic types. The first of these types moves the image in relation to a pick-up device. This usually means wrapping a photograph around a drum and spinning it in front of a light source and a photocell. This is the old facsimile or wire-photo system.

The second method of generating an electronic signal is to scan the image with a light beam. The flying-spot cameras used for converting movies to video by television stations in the 1950's and 1960's used this second method. A variation of this type scans the image with a photocell’s optics.

The third method of image conversion uses a television camera. These cameras consist of lenses which focus the images on the front of a vidicon tube. By scanning with an electron beam, the vidicon generates an electronic signal. (Williams, 1980)

The photodiode-array camera is the fourth method. This device is an integrated circuit with an array, or two-dimensional matrix, of thousands of photodiodes. Since this circuit digitally scans the image by looking at one photodiode at a time, the image produced is very stable. (Mayo, 1977)

Now we can look closely at standard video, like that which is used by the U. S. television stations. It takes 1/30 of a second to complete the scan of one frame. Since at this speed (30 fps) there would be a noticeable flicker, the image is actually scanned twice during the 1/30 of a second. The first scan is of the even numbered lines; the second is of the odd numbered lines. Each set of scans is called a field. Two fields make a frame.

Television contains, of course, the luminance signal, which provides the intensity values of the picture, and synchronization signals and, unfortunately, noise. Video noise, better known as “snow,” comes from a number of sources including the electronic circuits involved. Usually noise is not very noticeable because the eye averages out this short-lived randomness, but if look at a “frozen” or still frame, the noise becomes apparent. Since spacecraft, such as Voyager, send back one picture or frame at a time, noise can be quite a problem.

In an analog television system the amplitude of the luminance signal is proportional to brightness of each bit of the picture. This makes an analog system very sensitive to static since the amplitude of the noise is added to the signal.

The best way to limit the effect of noise is to use a digital system. In this type of system, we divide each line into dots or picture elements. These picture elements, called pixels for short, are converted to numbers. A picture returned from Voyager would consist of an array of 800 by 800 numbers, each number in the range of 0 to 255. These numbers are then used to reconstruct the picture with 0 being black and 255 being white.

This system has the advantage of being able to ignore noise since it only listens to the numbers.

A slightly different form of this system converts each pixel's level of intensity into a tone. This system is called Slow-Scan Television (SSTV). SSTV can be transmitted over short-wave radio using an SSB (single side band) voice channel on an amateur band. Other television signals, analog and digital, require a wide band or section of the radio frequency spectrum; slow-scan does not. This is because a small number of pixels (16,384 compared with 640,000 for Voyager) are transmitted slowly over a period of eight seconds.

This system has gained much popularity among radio amateurs since Robot Research (7591 Convoy Court, San Diego, CA 92111) perfected a computerized digital/analog scan converter called the Robot 400. The Robot allows viewing of slow-scan images on a normal television. The system works like this. To transmit a SSTV signal, the Robot "freezes" a field from a normal black and white TV camera or a video cassette recorder (VCR) and converts it to digital format: 128 by 128 pixels.
with 16 levels of brightness. (Thurber, 1980)

Using this digital information, tones are generated with black being 1500 Hz and each level being 500 Hz higher, placing white at 2300 Hz. The output signal also contains sync pulses of 5 millisecond for horizontal and 30 millisecond for vertical. These pulses are 1200 Hz tones. (Meyer, 1973)

Since these pictures consist of tones, they can not only be transmitted and received easily, but can also be recorded on any standard audio tape recorder. These audio tones allow the picture to be reconstructed by the Robot 400 or even a micro computer.

The technology behind such decoding is straightforward and impressive. Using a computer program by C. H. Galfo (602 Orange Street, Charlottesville, VA 22901), we turned our Apple II computer into a SSTV scanner. To do this, the SSTV signal is fed to the cassette input port. When the program is run, the screen clears and the picture starts building, one line at a time, from top to bottom. If you already have an Apple computer, this is a very low cost way to get started in slow scan.

Receiving SSTV signals on short-wave radio is not too difficult. Here at the Cincinnati Planetarium we used a Panasonic RF-4900 communications receiver. To find a slow scan signal, set the receiver on SSB mode and slowly tune up and down from one of the following frequencies:

- 3.845 MHz
- 7.220 MHz
- 14.230 MHz
- 21.340 MHz
- 28.680 MHz

The SSTV signal will sound bird-like, almost musical. Of course, the tones we were listening for here were pictures of Saturn.

These pictures were being sent from the Jet Propulsion Laboratory. As pictures were received from Voyager, the JPL Amateur Radio Club rebroadcast them via slow scan on 14.230 MHz or 21.340 MHz. Their station, W6 Voyager In Outer Space, is not always on the air, but for up to four or five weeks, it will be on the air. (Shapiro, 1980)

Out of the 110 pictures received here, eleven were reprocessed by computer to enhance the images and were then placed on a 5-inch floppy disk. These are being distributed by the Cincinnati Apple Siders Club. (If not available from your local club, the disk of pictures may be obtained from the author for $10.)

So for an exciting event, exhibit, or demonstration, you may want to set up a slow scan television receiving station (for help contact your local Amateur Radio Club). During the next Voyager encounter be sure to listen for “This is W6VIO going video.”

References


PETERS: Continued from page 27

I don’t regard it as too surprising that science fiction sometimes anticipates events. After all, ideas are a lot easier to render on paper than they are in metal, glass, silicon, electrons and photons (as anyone who has built special effects well knows). Some are bound to work out.

All three of the authors cited share one idea that’s still ahead of its time for a good fraction of the people in this planetarium business. Unfortunately some of us are still under the regrettable illusion that the bulk of the audience comes to a planetarium show for education, facts, astronomy; a one hour short course.

Well, it’s not true (even if the audience happens to arrive in a school bus). The protagonists in the stories react much as our audiences do. Whatever they may take away from our theatres they come for the very powerful environmental theatre-experience possible in our surrounding rooms. They leave with only a sense of disappointment if that experience is flawed or absent.

Though the stars, and their motion, are one of the most powerful visual experiences available in our domed environments, they are only one. And like the planetarium stars in the Sci-Fi stories, they should be incidental to the main flow of ideas, emotions, and the development of character.

To capture peoples’ minds, inspire them with our ideas, involve them with the emotions that we feel when we contemplate the universe, we must view our role as that of a dramatist rather than as a teacher or an astronomer. And even if our room has only stars and a few simple effects to offer, remember Hal Holbrook’s portrayal of Mark Twain. Drama of the most powerful kind can happen with a single actor on a very simply dressed stage.

Sources


WHEN THE STAR OF BETHLEHEM APPEARED

Douglas Johnson

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Christianity Today (December 3, 1976), the Griffith Observer (December 1980), and Oxford's Greece & Rome (April 1981) share the distinction of having published Dr. Ernest L. Martin's false theory concerning the time of Christ's birth. As you may remember, the Martin theory claims that the Star of Bethlehem appeared in 3/2 B.C., that Christ was born in 2 B.C., and that Herod died in 1 B.C.

Since refuting the Martin theory in the Planetarian (Spring 1981, Vol. 10, No. 1), I have become aware of more evidence that might interest Dr. Martin, Mr. Billy Graham (founder and Board member of Christianity Today) and the publishers of Christianity Today, the Griffith Observatory, the publishers of Greece & Rome and the many other people fascinated by this subject. And I'm happy to report that my refutation of the Martin theory has received support from two scholars in the United Kingdom.

Dr. E. Mary Smallwood, Professor of Romano-Jewish History at The Queen's University of Belfast, Northern Ireland, gave me permission on August 11, 1981, to publish her following statement:

"I entirely agree with Douglas Johnson's refutation of the Martin theory. All of the evidence points to 4 B.C. as the year of Herod's death.

"There is no evidence to support Martin's idea that Antipater was Herod's co-ruler. None of Herod's sons co-ruled with Herod.

"I'm very dubious indeed about Martin's re-dating of the reigns of the legates of Syria—a re-dating on which part of Martin's chronology rests. Likewise, I do not accept Martin's conclusion concerning the Tibur inscription.

"In conclusion, I consider the Martin theory to be wholly untenable."

Dr. Frederick F. Bruce, former Rylands Professor of Biblical Criticism and Exegesis at the University of Manchester, England, was previously on record as favoring the Martin theory. Recently, Dr. Bruce changed his position by withdrawing his support for Dr. Martin's dating of Herod's death. Dr. Bruce gave me permission on August 31, 1981, to publish his following statement:

"I have long been on record as accepting 4 B.C. as the date of Herod's death and I have seen no reason to change my mind. Though I disagree with his date for Herod's death, I commend Dr. Martin for reopening this issue with his reasoned argument. I think Dr. Martin has made a positive contribution to historical scholarship with his interpretation of the Tibur inscription."

Now let's turn our attention to the evidence giving us a reliable chronological framework for our search for the Star of Bethlehem.

CORRECT CHRONOLOGICAL FRAMEWORK

After carefully examining the historical evidence, the chronological framework around the rising Star of Bethlehem may be discerned. The following chain of evidence should be of help to audiences seeking orientation on this subject.

Augustus Caesar defeated the naval forces of Antony and Cleopatra at the Battle of Actium in 31 B.C. Roman history books, encyclopedias covering Roman history, and detailed dictionaries (like The American Heritage Dictionary) confirm the accuracy of this date. Professor E. Mary Smallwood states that the 31 B.C. date for this battle is "absolutely secure."

According to the first century A.D. historian, Flavius Josephus, Archelaus (a succeeding son of Herod) was banished from the throne of Judea 37 years after the Battle of Actium. It must also be understood that Josephus counted part of a year as a whole year. Thus, Josephus used inclusive reckoning of years and we arrive at 6 A.D. for the banishment of Archelaus.

Josephus reports that Archelaus was banished in the tenth year of Archelaus' rule. Thus, we discover that Archelaus counted his reign from 4 B.C. Only three questions remain:

Did Archelaus, Antipas, and Philip (Herod's three succeeding sons) co-reign with Herod for three years and then begin reigning on their own in 1 B.C.? No, because Augustus Caesar prohibited Herod from allowing anyone to share Herod's kingship; an heir would only become a ruler after the death of Herod. Also, the three sons were nominated as heirs to the throne too late in Herod's lifetime to have co-reigned with Herod for three years. Archelaus was named as an heir just a few days before Herod died.

Was Antipater sole ruler of Judea for three years making it possible for Herod's three succeeding sons to appropriate Antipater's regnal years in 1 B.C.? No, because Josephus refers to Herod as "king" of Judea until Herod's death. (The only situation requiring the three sons to blot out Antipater's rule would be if Antipater had been sole ruler of Judea before a severe disgrace. If Antipater had had a co-regent with Herod, the three sons would have merely counted their reigns from the end of Herod's co-reign. However, both of these propositions are false.)

Did Antipater co-reign with Herod for three years making it possible for Herod's three succeeding sons to appropriate Antipater's regnal years in 1 B.C.? No, because Antipater was only an heir who acted "as if" he were a ruler while the burden of office fell upon Herod alone. Antipater never reigned in Judea. (For detailed evidence, see below.)

Therefore, Archelaus, Antipas, and Philip actually began reigning in Judea in 4 B.C. (not in 1 B.C.) after the death of their father, Herod.

Since Christ was born while Herod was still alive (Matthew 2:1), Christ was born no later than 4 B.C.

Because Christ was "about thirty years of age" when he was baptised in 28 or 29 A.D. (Luke 3:21, 23), Christ was born no earlier than 7 B.C. If Christ was born in 6 B.C. and was baptised in 28 A.D., he would have begun his ministry at the age of 33 (a reasonable conclusion permitted by Luke's clue).

Therefore, the Star of Bethlehem heralding the birth of Christ must have risen in the sky between 7 B.C. and 4 B.C.

HEROD'S RECONCILIATION

Dr. Martin claims that Herod was disgraced and demoted by Augustus Caesar in 4 B.C. and that this event led to the reign of Herod's son, Antipater, in Judea. This is simply false.
Herod's disgrace in 8/7 B.C. was of little consequence because, after a short period of time, Herod regained the favor and confidence of Augustus through the diplomatic efforts of Nicolaus of Damascus. Josephus emphasized the fact of Herod's reconciliation with Augustus by reporting it three times in Jewish Antiquities. This reconciliation was achieved no later than 7 B.C. because at this time Saturninus was governor of Syria. (Saturninus governed immediately before Varus and coins prove that Varus governed Syria from 7/6 to 5/4 B.C.\(^5\))

Thus, Herod's disgrace (incorrectly dated by Martin) simply meant that Herod temporarily lost his favorable designation as a "friend of Caesar." There is no evidence suggesting that Herod ever lost or shared his kingship. Herod reigned as king of Judea until his death.

**ANTIPATER NEVER REIGNED**

Dr. Martin claims that Antipater had three regnal years which were later appropriated by Archelaus, Antipas, and Philip. This claim is false and Antipater had no regnal years for the following reasons:

1. According to Josephus, Herod received this order from Augustus concerning Herod's eventual choice of a successor to the throne of Judea. "And when Herod was disposed to make such a settlement at once, Augustus said that he would not give him leave to deprive himself, while he was alive, of the power over his kingdom, or over his sons."\(^10\)

2. After receiving the order from Augustus, Herod made a speech to the people of Judea. According to Josephus, Herod told the people that his sons were to reign "after him."\(^11\) Herod named Antipater first among the three sons he chose to succeed him. Then Herod reminded the people that "he desired that they should all pay court to himself, and esteem him king and lord of all."\(^12\) Herod's position as king and Antipater's position as favored heir are clearly described by Josephus in The Jewish War, I, 23, 5 (Loeb) when he offers us the following portion of Herod's speech,

"I must require these persons . . . to rest their hopes on me alone; for it is not the kingdom, but the mere honours of royalty, which I am now delivering over to my sons. They will enjoy the pleasures of power, as if actual rulers, but upon me, however unwilling, will fall the burden of office" (emphasis added).

3. Josephus offers additional evidence in Jewish Antiquities, XVII, 1, 1 (Loeb) that Antipater was not a co-regent or king when he writes that Antipater found it "hopeless to obtain the throne" because he was hated by the people and the army.

When Josephus makes the paradoxical statement in the same section that, in spite of Antipater's "hopeless" condition, Antipater was "at least co-ruler with his father and in no way different from a king," Josephus is measuring the honors of royalty allowed to Antipater by "concession" from King Herod; he is not referring to a change in Antipater's legal status from favored heir to legal king.

If Antipater had been a co-regent, Josephus would have said so straight out. Because Antipater was not a co-regent (but a favored heir), Josephus described Antipater as "at least co-ruler" in an effort to measure his honors of royalty. Antipater had de facto influence, not de jure power.

Dr. Timothy D. Barnes, Professor of Classics at the University of Toronto, Canada, translates the relevant passage in Jewish Antiquities, XVII, 1, 1, as, "Nevertheless [Antipater] ruled with his father just as if he were king." This proves that Antipater was not a co-regent or king, but merely an heir to the throne who acted "as if" he were king because of Herod's favor toward him.

It's important to note that this description of Antipater by Josephus in Jewish Antiquities exactly matches his earlier description in The Jewish War, I, 23, 5 (see 2. above). Notice especially the decisive identical phrase, "as if." Whatever authority was given to Antipater was allowed only as a "concession" from his father, King Herod, who remained king.\(^13\) Josephus refers to Herod as "king" in the section of Jewish Antiquities mentioning the concession. A "concession" is a privilege granted by the controlling authority; in this case, King Herod was the controlling authority.

4. After being named heir to the throne in his father's last will, Antipater left Jerusalem with the last will and testament to rule after Herod's death and after appointment by the Roman Emperor.

5. While living in Rome for at least seven months, Antipater continually sought to have his father murdered.\(^15\) This leads us to ask two very important questions:

a. Could Antipater have ruled Judea as king or co-regent while he was living in Rome? The answer is obvious: no. And, b. Why did Antipater continually try to have his father, Herod, murdered if Antipater were already king? Again the answer is obvious: Antipater was merely an anxious heir to the throne who was trying to kill the king in order to speed up his inheritance. (In fact, Antipater was such an anxious heir that he lamented King Herod's long life and complained that if he ever gained the throne of Judea from his elderly father, he would be too old to enjoy it.)\(^16\)

Antipater's plan was to have Herod murdered by others and then Antipater would have gained the throne of Judea with the last will in his possession and, through his absence from Jerusalem, remained free of suspicion.
6. Herod learned of Antipater’s plan to murder him and invited Antipater to return to Jerusalem from Rome. Varus, the governor of Syria, was visiting Herod when Antipater arrived from Rome and Varus assisted Herod in Antipater’s trial the next day. As proved earlier, Varus governed Syria from 7/6 to 5/4 B.C. Therefore, Varus assisted in this trial no later than 4 B.C.; 5 B.C. is a likely year. Antipater was accused and soon convicted of conspiring to murder Herod. Antipater was immediately imprisoned and later executed five days before Herod’s death.

7. Josephus makes it clear in The Jewish War, I, 32, 2 (Loeb) that at the time of Antipater’s trial before Herod and Varus, Antipater had been nominated in Herod’s last will as “heir to the throne,” but he progressed no further. For all of these reasons, Herod the Great was king of Judea until his death and Antipater never reigned in Judea.

8 STADIA
In a single and uncorroborated report, Josephus tells us that a lunar eclipse immediately preceded Herod’s death.19 Herod’s funeral and its attendant events were then accomplished before the following Passover. In view of the evidence establishing the date of Herod’s death as 4 B.C., the lunar eclipse of March 13, 4 B.C., is a reasonable choice to fit Josephus’ report.

But Dr. Martin claims that there is not enough time between March 13 (the eclipse) and April 11 (the beginning of Passover) of 4 B.C. for the funeral of Herod and its attendant events. The Griffith Observer (December 1980) considers this proposition to be Dr. Martin’s “main contribution” to the resolution of this issue.

First, Dr. Martin is not the first person to make this proposition. And second, this proposition is false.

When William Whiston translated the works of Josephus in 1737, he suggested in a footnote that Herod’s funeral procession traveled 8 stadia (about one mile) each day for 25 days to cover the 200 stadia between Jericho (where Herod died) and Herodion (Herod’s burial site).

The Loeb Classical Library, published by Harvard University, contains the works of Josephus. The volume of Jewish Antiquities containing the account of Herod’s funeral also contains a footnote suggesting that Herod’s funeral procession traveled 8 stadia “each day” to cover 200 stadia.

If these footnotes are correct, there may be insufficient time between the eclipse and Passover of 4 B.C. for the events described by Josephus.

However, these two footnotes (and Dr. Martin’s claim that Herod’s funeral procession required 28 days) are false. Josephus simply says Herod’s funeral procession “went eight stadia toward Herodion.”20 The phrase “each day” does not appear in Josephus’ text. Therefore, Josephus recorded “eight stadia” as a total extent of travel, not as a rate of travel.

Herod’s ceremonial funeral procession traveled about one mile through the streets of Jericho for the benefit of the onlooking Jericho population. Hundreds of mourners did not walk one mile each day for 25 miles through the desert wilderness.

There are practical reasons why the procession walked only one mile as reported by Josephus.

1. After its 8 stadia march (requiring about 1/2 hour) each day through the desert, the procession would have spent the remainder of the day baking in the sun.

2. The procession would have required a huge caravan loaded with provisions for food and lodging for 25 days.

3. With a large portion of the army off-duty for almost a month to walk in the procession, the kingdom’s security would have been weakened.

4. There would have been no audience in the wilderness, as there was in Jericho, to appreciate the jeweled splendor of the procession. And,

5. If Lazarus “stunk” after four days in a cave shortly before Passover (John 11:39, 55), imagine the condition of the deceased king after 25 days of exposure to the sun shortly before Passover. Predators from land and air would have caused serious problems for the procession in the desert.

I’m not the first person to realize that the procession traveled only eight stadia. Emil Schurer, a 19th century historian, confirms this understanding of Josephus’ text.

Therefore, I conclude that Herod’s funeral procession walked only eight stadia for the benefit of the onlookers in Jericho. The deceased king was then likely transported the remaining 192 stadia to Herodion in a horse-drawn wagon escorted by a company on horseback. The funeral required no more than two days and was probably accomplished in one day.

Perhaps it’s interesting to note how Dr. Martin’s own calculation makes the 4 B.C. eclipse a possible choice. Dr. Martin claims that a minimum of 54 days were required for the events between the eclipse and Passover. He adds that the funeral procession required 28 days.

So, take his 54 days, subtract 26 days (because the procession required no more than two days), and 28 days remain to accommodate the events between the eclipse and Passover. There just happen to be 28 days between March 13, 4 B.C. (the eclipse) and April 11, 4 B.C. (Passover).

Thus, after correctly understanding Josephus’ text, we see that there is no compelling reason to dismiss the 4 B.C. eclipse as the one reported by Josephus. In fact, after considering all of the evidence, this eclipse is the only logical choice.

Acceptance of the March 5 B.C. eclipse would mean Herod’s succeeding sons began reigning in 5 B.C. The evidence shows that the sons began reigning in 4 B.C.

Acceptance of the September 5 B.C. eclipse would mean Herod’s succeeding sons waited nearly seven months after Herod’s death before traveling to Rome (after Passover) to have their inheritance confirmed by Augustus. This simply isn’t likely.

Acceptance of the January 1 B.C. eclipse would mean Herod died in 1 B.C. The evidence proves that Herod died no later than 4 B.C.

Therefore, the lunar eclipse of March 4 B.C. is the one reported by Josephus. Herod died in the spring of 4 B.C.
HEROD'S CRUELTY

Dr. Martin claims that Herod would not have killed two prominent Jewish teachers on the last day of the festival of Purim. (Josephus reports that Herod killed the teachers on the night of the lunar eclipse. March 13, 4 B.C., was Adar 15 of the Jewish year—the last day of Purim.)

The opposite is true. Killing two teachers on the last day of Purim was entirely consistent with Herod's pathological cruelty. For the same reason that Herod planned to kill hundreds of Jewish nobles immediately before his death, Herod also killed the teachers on the last day of Purim: Herod sought "vicarious mourning" from the Jewish nation who hated him. (Herod's family released the nobles unharmed immediately after Herod's death.)

MARTIN THEORY DISMISSED

For all of the above reasons, the Martin theory is false and may be dismissed. Now that the correct chronological framework for Christ's birth has been established, let's bring some additional considerations into view.

ASTRONOMY

Since we're looking for the Star of Bethlehem between 7 and 4 B.C., the triple conjunction of Jupiter and Saturn in 7 B.C. (followed by a three-planet grouping in early 6 B.C.) becomes an interesting candidate. Herod and all of Jerusalem were surprised by the wise men's report of the star. Thus, the appearance of the star was not obvious.

Because Jupiter and Saturn rose together as "morning stars" on May 27, 7 B.C., we may be reminded of God describing to Job the creation of the world when "the morning stars sang together, and all the sons of God shouted for joy" (Job 38:7). The wise men also expressed "great joy" upon seeing the star.

The Jupiter-Saturn conjunction on October 5, 7 B.C., coincided with the holiest day of the Jewish year—the Day of Atonement. This "star" may have signaled the birth of the promised Redeemer—the one who brings forgiveness and eternal redemption.

The time between the rise of the "star" in May 7 B.C. and its setting in February 6 B.C., as part of a three-planet grouping, is equal to a normal period of time between a woman's conception and her giving birth. Does this suggest Christ was born in the spring of 6 B.C.?

The fact that these three conjunctions of Jupiter and Saturn took place in the constellation of Pisces (the Fish) brings to mind the "sign of Jonah" (Matthew 12:38-41). Maybe this prophecy mentioned by Christ refers to both the birth and resurrection of Christ. The prophet, Jonah, was in the fish for three days before he was delivered; the "star" in the "fish" was prominent to the wise men on three days before Christ was born; and Christ was in the "fish" of the tomb for three days before he was resurrected to eternal life.

PROPHETIES Fulfilled?

God's conversation with Job may hold further clues to the birth of Christ. God speaks of a birth "out of the womb" at Job 38:8 (Mary giving birth to Jesus?); "my decreed place" at Job 38:10 (Bethlehem?); and the garment of "a swaddling band" at Job 38:9 (the swaddling clothes around Jesus mentioned at Luke 2:72). These are probably the only two passages in the Bible mentioning swaddling clothes.

And have you ever considered the amazing Book of Esther (a Bible story centered in the Babylonian region where the wise men are thought to have begun their journey)? The story of Esther mentions "wise men who knew the times": two victorious cousins—Esther and Mordecai (remember, Elizabeth and Mary who gave birth to John the Baptist and Jesus were cousins); and the wicked Haman who had ten sons (Herod, who tried to kill Jesus, also had ten sons24). The Jewish festival of Purim has its origin in Esther. Is the story of Esther a prophecy suggesting that Christ was born near the time of Purim?

The Jewish month of Adar was the last month of the year. It's interesting to note that Christ is called the "first Adam"—the last member of Adam's generation (1 Corinthians 15:45). And Christ was resurrected to new life in the first month of the Jewish year, Nisan (1 Corinthians 5:7).

Was Christ born in Adar and resurrected in Nisan to confirm that he is the last member of the former age and the first member of the new age—the "First and Last"?

ETERNAL LIGHT

In the beginning, God created his light to shine into the world. The wise men saw the light unto the Gentiles. And the star forever reminds us of that light shining through the birth and resurrection of Christ.

Jesus was born in a hillside cave used to shelter sheep near Bethlehem when no room was found for him at the inn. He was later reborn from a cave "hewn out of rock" near Jerusalem.

As an infant, Jesus was wrapped in swaddling clothes (strips of linen also called "swaddling bands") by his mother. Years later, Joseph and Nicodemus wrapped the body of Jesus in "strips of linen."

When Jesus was born, wise men came from the east to present him with frankincense and myrrh. On the day of the resurrection, Mary Magdalene brought spices to anoint Jesus.

The birth of Jesus was heralded by a rising star while his resurrection was proclaimed by the day star—the rising sun.

Angels proclaimed the birth and resurrection of Jesus.

Eight days after his birth, Jesus was circumcised in Bethlehem. Eight days after his resurrection, Jesus "circumcised" the heart of Thomas to remove his doubts.

Forty days after his birth, Jesus ascended to Jerusalem from Bethlehem with his parents to be presented in the temple of God. Forty days after his resurrection, Jesus ascended to the "Jerusalem above" from Bethany to be presented in the temple of Heaven.

And at least fifty days after his birth, Jesus was revealed to the wise men who had journeyed so far to find him. Fifty days after his resurrection, Jesus was revealed to everyone by the gift of the Holy Spirit.

CONCLUSION

After the debate concerning the time of the Star of Bethlehem and the birth of Jesus has spawned its last remark (or perhaps sooner), we may realize that the "star" of God is fulfilled in the birth of Jesus and the eternal reign of the Holy Spirit.25

As we are so powerfully and joyfully reminded by the words of God and George Frederick Handel's "Messiah":

And He shall reign forever and ever.26 Hallelujah! Hallelujah! Hallelujah! 

continued on page 16
HEMISPHERIC FUNCTIONS AND A RIGHT-BRAIN EXPERIENCE

EDITOR’S NOTE:
This article is based on a paper presented at the 1978 International Planetarium Society Biennial Conference, Washington, D.C.

Humankind has a tendency to look at the world in terms of two complimentary categories: order and disorder, yin and yang, science and art, reason and intuition. Yet it is not so much that humans have split nature as that natural evolution has divided their thinking abilities.

In recent years psychologists and neurologists have come to recognize that different functions are performed by different halves of the brain. The left side is considered the most advanced in an evolutionary sense. It is endowed with language and analytical abilities. The right side has more in common with other vertebrates than the left; it is intuitive and holistic. The right brain hemisphere extracts meaning from art, poetry, rhythm, music, metaphors, comparisons, discrepant events, and open-ended questions. The right brain is closely linked to perception via the senses, taking note of shape, color, sound, smell, taste, touch and muscle (kinesthetic) experiences. While the left brain takes incoming information a little at a time, like a computer, the right brain processes new and remembered information simultaneously. The left is logical, hierarchial, and propositional, well suited to the understanding and use of the scientific method. The right regards with emotion, reasons with analogies, and forms attitudes.

The right brain hemisphere is frequently straitjacketed by the orientation of educational systems. Probably formal education is left-brain oriented because 85 percent of the population prefer to think and operate with primarily the left brain. Most people are “left-brain dominant.” Robert Ornstein notes that awareness of the right brain functions is a little like the inability to see stars in the daytime: the verbal ability of the left brain obscures the sensing, imaging functions of the intuitive right brain. However, there are “right-brain dominant” individuals, and they frequently are at a disadvantage in the left-brain school world. They are prevented or inhibited, following primary school activities, from using the thought channels which they prefer.

In his book, The Dragons of Eden Carl Sagan has built a case for the evolution of human intelligence and culture being a function of the development of the corpus callosum, the nerve connection between the two brain hemispheres. I suggest that creativity and competence in each individual are a function of opportunities for interaction of the right brain and the left brain, regardless of the individual’s brain side dominance. Regardless, greater proficiency with right brain abilities are certain to give an individual greater potential in coping with the world. Greater use of techniques which nudge each person’s right brain into action is implicated.

Famed scientist and philosopher Jacob Bronowski admired the creative work of some astronomers, which certainly utilized right brain thinking: Copernicus mentally lifted himself from the Earth and put himself wildly, speculatively into the sun. Kepler felt for his laws by way of metaphors. And Einstein claimed he always discovered things first with his “metaphoric mind” and let his analytic mind work things out in unexciting labor afterward. (It is interesting that Isaac Asimov, a giant among science and science-fiction writers, claims that he thinks in words only because he cannot visualize creative images. Although a number of his stories have been adapted by others, he will not write a planetarium program for this reason. Asimov seems to be an exception among creative individuals.)

What is the relevance of understanding hemispheric functions to planetarium interpretation and production? First, it provides a rationale for using the planetarium as a worthwhile and important educational aid for all age levels and in a variety of learning situations—perhaps a greater rationale than most planetarium research results have offered. Second, the understanding gives impetus to utilizing a variety of methods within the planetarium, to expanding the use of the planetarium as a multi-sensory auditorium. Support is rendered for many techniques which improve both conceptual learning about the universe and appreciation of it.

Some of the methods which are calling forth the right brain abilities of audiences are cosmic concerts, drama under the stars, and situations which include the active participation of planetarium attendees. All planetariums which use vivid diagrams, descriptions with analogies, music which hints at ideas, and multi-auxiliary effects where appropriate are tuning in the right brains of their audiences.

As an example of an additional experience which can be used in learning and appreciating astronomy, I will here relate a “mind journey” also known as a fantasy trip and guided imagery. A mind journey can be as powerful for producing learning as many auxiliary projectors, and considerably less expensive. A mind journey can be assisted by auxiliaries, if one chooses. Some A-V-assisted fantasy trips are the Houghton Mifflin computer-generated astronomy films, “Explorations in Space and Time,” and the “Powers of Ten” film based on the Kees Bok book Cosmic View. A mind journey doesn’t have to have associated visuals. The imagery can be provided by the right brain activity of each individual.

I quote from Norton Juster’s book, The Phantom Tollbooth: “How can you see something that isn’t there? yawned the Humbug.”

“Sometimes, it’s much simpler than seeing things that are,” Alec said. “For instance, if something is there, you can see it only with your eyes open, but if it isn’t there, you can see it just as well with your eyes closed. That is why imaginary things are often easier to see than real ones.”

Jeanne E. Bishop
Those who are used to operating more scientifically, more dependent on the exactitude and abstraction of the left brain (and most of us are) may find guided imagery a little difficult at first. It may be like learning to rethink as a child has to; children are naturally much more capable with their right brains than their left. If one follows with a loose (but not silly attitude), most cannot help but feel the dynamic synthesis of experience as the brain hemispheres cooperate to create meaning. Watch for the integrated use of music, rhythms, body feeling, analogies, discrepant events, vivid words which call up images and feelings, poetry (there is part of a poem by Natalie Belting hidden in the mind journey), and different spatial and personal perspectives. I have used this technique with children of many ages and adults. I have found it especially useful in conveying concepts about the distances and organization of bodies within space to learning disadvantaged children.

We are about to take a journey into the vicinity of a black hole. I've adapted this idea from Harry Shipman's discussion in Black Holes, Quasars, and the Universe. The music is from a well-known science fiction movie.

Close your eyes. Sit relaxed. Feel the tension loosen from your neck/your shoulders/your arms/your legs. But stay mentally alert.

You are a great distance out in space. You have left a parent rocket ship in a probe. It is designed to explore the field around a black hole. You look ahead directly at the black hole. You squint your eyes/straining/trying to catch a glimpse of a small, black, round dot against the backdrop of twinkling stars but you don't see it. Just the twinkling stars/so beautiful/like reindeer or fishes swimming/water lilies/kangaroos/fires which ghosts have lit/a woman's beautiful necklace/shining paths of ice/themselves holes in the canopy of heaven./But there is something odd/a small constellation of these beautiful stars, right where the hole is supposed to be, is larger than it was when you saw it on the backside of the hole. Yes, the stars have spread apart/like a hand which has spread its fingers/like a telescopic view of daisies/like baseballs thrown from those stars/light has swerved toward the massive black hole.

(Music tempo changes dramatically)

You are stretched./You are pulled./Every muscle in your body groans./Every fiber aches/like giant hands holding your feet/holding your upraised hands and pulling in opposite directions/against your will/as on the rack of a medieval torture chamber./The black hole has you in its grip./Your shoulders are squeezed/as if in a vise./Your elbows dig into your rib cage./Your knees seem to lock together./Your ankles press together in agony. But you are courageous/and indestructible.

(Transition in music)

With great effort you move./You have work to do./You are closing in on the black hole/that frozen star./You are going to throw ticking clocks out of your probe as you go swiftly, like a bullet, toward the event horizon./You will look back at a huge luminous clock, a red clock, on the mother spaceship/and compare times.

(Another transition in music; very rapid tempo)

Down/in/around you throw clock one/mother ship clock time: one-twentieth of a second faster. You let a second clock go./You're as close to the event horizon as New York City is to Washington, D.C./mother ship clock time: three twentieths of a second faster./That clock now looks yellow./Another clock/mother ship clock time faster and faster/mother ship clock looks green/mother ship clock disappears in a flash of violet./The event horizon is upon you./You are through./Nothing special about going through./Now/in a split second/at the center of the hole/the singularity.

(Last transition in music; very slow)

You zoom in thought to the mother ship./What do your friends there see?/They see your clocks./They see you./Each clock in orbit./The closest clock to them looks green and brightest./The next looks yellow and fainter/each slightly slower/the next red/the next--invisible/except with a powerful infrared scope, an image tube./And you... you in that scope have come to rest on the event horizon/never going through/seemingly there forever/for as long as people will explore this realm/and look with great image tubes/there you will seem to be frozen in time and space.

Please open your eyes slowly. Do not forget your thoughts and feelings. How were you affected by your mind journey?

If you use this technique, I suggest that you remember to 1) speak slowly and with emphasis; 2) allow a brief time to orient the audience to what you plan to do and another short period after the experience in which to preserve the awareness which guided imagery evokes; and 3) do not make any segment of mind journey too long, or you may destroy the mood. Additional points about guided imagery can be found in an article by Robert McKim (1977).

Mind Trip

Imagination can make the trip Denied to any realistic ship.
Light-speed limit is left behind When hyperdrive is in the mind
And weatherclouds of dust and gas, Spanning the light years, quickly pass.

Thomas Clarke (excerpted)

References

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More Sadness. Hampton, Virginia Schools closed Planetarium Richard Joyce’s place for 1981–82, due to budget cuts. Borrowing some word patterns from Jack Horkheimer’s “Starbound,” Richard writes, of the closing:

Once upon a time
in a city not so far away
there existed a city council strange,
with an insatiable urge to devour schools.
The more it ate the less it had;
the less it had the more it ate.
Now this is the sad part:
the mess it left behind
fell on shoulders . . . of men noble and bold
who had feelings and hearts that were not cold
but even their best efforts could not cope
and the planetarium doors will be closed with rope.

Ed Leach’s planetarium in Chesterfield County, VA is also closed for 1981–82. But Ed suggests we not get too morose; he suggests, instead, the formation of a new Association. He calls it the Association of Former Planetarium People. (Allen Varn, formerly at Bishop Planetarium in Bradenton, Florida, apparently foresaw this; four years ago, he had a business card printed up, saying “Former Planetarium Director.”) Now where does the group meet? Ed says: “Why, former planetariums, of course!” For awhile, it seemed that Abrams Planetarium in East Lansing, Michigan, would issue the first invitation for a meeting. (Thankfully, they now have a reprieve.)

At a meeting of the Association of Former Planetarium People, the participants could stay in former hotels, eat in former restaurants, and speak of former stars. Imagine the puzzlement of Internal Revenue Service agents when business trip deductions appear on the returns of the Former Planetarium People! Ed is trying to arrange a meeting for next summer at a lovely cabin in Maine he knows about (not exactly a former planetarium, but . . .). Makes you kinda have something to look forward to, just in case . . .

Overheard at SEPA Meeting, June 1981, in Memphis

Ruth Lewis of Craigmont Planetarium in Memphis observed SEPA conference in the lobby milling around between planetarium shows at Craigmont. She noticed how their random milling movement terminated in a general pattern which looked sort of like a circle and each would glance up repeatedly. A flash of insight struck her: “That’s it! In recent years I thought these ugly marks on my neck under my chin were age wrinkles; now I realize they’re stretch marks from constantly looking up!”

Transportation from motel to planetarium was by car pooling. No one was left behind. Larry Miller of Sudekum Planetarium in Nashville caught a shuttle on the luggage rack of a Fiat X19 belonging to Jim and Cathy Summers of Fernbank Science Center in Atlanta. Carollyn and Mark Petersen, of Loch Ness Monster Productions in Boulder, Colorado, found the high point of their day to be when they discovered that “this is a much bigger back seat than the last one we rode in!”

Professor Emeritus Bart Bok of the University of Arizona, a guest speaker at the conference, was in attendance at an elegant wine and cheese party given one evening by the Memphis Pink Palace Museum. Each table laden with goodies was adorned with a little flag representing a different country of the world. Professor Bok entertained conferees by lifting up each tiny flag and singing the national anthem of the country it represented!

Ray Shubinski, director of the Memphis Museum, proudly explained how his conference was going to be different than others attended by SEPA members. He said, “Not a single motor will be given away as a door prize!” True to his word, the grand prize was an autographed paperback copy of Erich von Daniken’s Chariot of the Gods.

“Ogden’s Trial by Magic,” a special planetarium show, had an adversary setting as Tom Ogden, a live magician, pitted his tricks against the special effects of the planetarium. Conversations between Ogden and “the planetarium” established the “Can you top this?” scenario. The contest ended, after planetarium storm sequence vs. fire tricks, etc., with no clear-cut victor. It was great fun for the audience until they left the chamber and stepped outside to be met by a sudden and violent thunderstorm which completely drenched everyone. H-m-m-m! A third contestant?
The President's Message

THE SCIENCE FICTION PLANETARIUM
William T. Peters
President, I.P.S.

This spring, when I returned from the mid-Atlantic Planetarium Society Conference in Philadelphia, I gave my Astronomy class at the University of Winnipeg a rather enthusiastic account of the Evans and Sutherland Digistar planetarium projector. Mike Dyck, one of my students, hurried up to me after class with the comment:

"Asimov predicted the Digistar! It is in Second Foundation."

My recollection of Second Foundation had faded over the years, since I too had read it as a college student, but Mike located the passage for me:

"The Lens was perhaps the newest feature of the interstellar cruisers of the day. Actually it was a complicated calculating machine which could throw on a screen a reproduction of the night sky as seen from any given point in the Galaxy."

"Channis adjusted the coordinate points and the wall lights of the pilot room were extinguished. In the dim red light at the control board of the Lens, Channis' face glowed reddily. Pritcher sat in the pilot seat, long legs crossed, face lost in the gloom."

"Pritcher had watched the phenomenon of Lens Image expansion before but he still caught his breath. It was like being at the visiplate of a spaceship storming through a horribly crowded Galaxy without entering hyperspace. The stars diverged towards them from a common centre, flared outwards and tumbled off the edge of the screen. Single points became double, then globular. Hazy patches dissolved into myriad points. And always that illusion of motion."

Certainly Asimov has captured both the principle of the Digistar and the impression it makes on its audiences, in the narrative about the Lens. "Lens" is even a good word for it, since all that's seen of the Evans and Sutherland device in the star theatre is the great curved pool of glass that forms its fisheye projection lens.

Asimov conceived the Lens as an aid to navigation rather than a device for entertainment and education. After a hop through hyperspace, it was necessary to find out just where the ship was when it reappeared in normal space. Asimov had his characters find their location by spectroscopically analysing inherently bright stars, stars that shine as beacons far across the galaxy. When a likely star is spotted, the Lens was used to confirm the identification, by attempting to match the starfield around the suspected star in its memory, with the one superimposed from the spaceships' observation screen. When the match was exact, the Lens provided a readout of the ship's position in a Galactic coordinate system.

Asimov's Lens goes far beyond the abilities of the Digistar in the size of stellar data base it can handle, a hundred million stars compared to about 10,000 for Digistar. But then we only know the properties of around 100,000 stars well enough so the data would be useful in a machine like the Lens.

Perhaps Evans and Sutherland's "Lens" along with all the other planetarium machines will help provide the inspiration so that people will ultimately explore our galaxy in enough detail to make Asimov's Lens possible, and necessary.

Asimov's Lens, however, seems to lack one feature that I consider essential for a Planetarium . . . a dome. I am convinced that the surrounding environment is as important to the "Planetary Experience" as the ability to produce and manipulate stars.

Since Mike Dyck called Asimov's "planetary" in Second Foundation to my attention, I've become rather a collector of occurrences of planetarium-like devices in Sci-Fi.

In their Inferno (an updated romp through Dante), Larry Niven and Jerry Pournelle postulate a planetarium. It marks only a minor event along the path that their modern Sci-Fi-fan hero takes as he traces Dante's path through Hell.

Here is how he describes it:

"I . . . tried the joystick again. The universe came up and hit me in the face. Whoosh! Stars shot past and around me; a sun came at me and exploded into a fraction of a second of intolerable brightness and was gone. And I was flat on my back a couple of yards from the console."

"That was some planetarium!"

Niven and Pournelle's planetarium has a dome, at least it is externally dome-shaped. Inside, they describe it as a silver ring, twelve feet tall and standing on edge. The ring fills with stars when the console is switched on. This isn't very clear, but they seem to have a surrounding, dome-like, perhaps 3-D environment in mind.

In "Rabid in Mallworld," a short story in his continuing Mallworld series, Somtow Sucharitkul introduces the holoZeiss. Mallworld is a cosmic caricature of a shopping mall, a space station of businesses, bustling humanity and aliens (alienamity?!) attracting customers from all over the Solar System. The Galaxy Palace, Mallworld's premier restaurant, is surmounted with a dome. The last surviving holoZeiss fills this dome with the stars as they looked before the alien masters sealed off the Solar System to prevent the spread of a burgeoning and aggressively dangerous human civilization.

Sucharitkul doesn't describe the properties of the holoZeiss beyond its ability to produce a haunting vision of the universe:

"The ballroom, wonderstrung, hushed as a cathedral. My eyes getting used to the dimness, and then--"

"Starlight stared down from a past when men had a future. Oh god, the pain in my gut, the anger, the longing . . ."

"Why do we even go on? I thought, Why have children, why live? I dropped the tray. Glass splintered. I heard it as if it was worlds away."

After this bit of mellowdrama, Sucharitkul's waitress-protagonist is off on a humourous, farcical adventure involving one of the blue-skinned humanoid masters, with flaming magenta hair. The holoZeiss was great for business at the Galaxy Palace, and apparently that's just what the owners of the "Saint" in New York City had in mind when they installed a dome and a Spitz STP above their dance floor.

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