IPS'90
Galaxen, Borlänge
Sverige
15-19 juli
The Boundless Planetarium
Proceedings
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Lars Broman and Mariana Back, editors
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FOREWORD

To host the Tenth Biennial International Planetarium Conference The Boundless Planetarium during some very hectic summer days in Borlänge was a great experience for us. However, being busy in keeping delegates and guests busy did not leave much time over to attend all the sessions. It has therefore been a most rewarding task to collect and read the contributions to this book, and we want to thank all the authors whose combined efforts have resulted in these Proceedings.

We are now able to present to the worldwide planetarium community what we hope will be a collection of papers with lasting value. For ease of reading, we have assorted the contributions under ten different headings. Most of the presentations at IPS'90 are here, and only a few are missing. In the Contents, invited lecture titles are written with bold letters and workshop reports with italics. Towards the end of the book, you will also find the list of delegates, completed with non-present authors, and a list of the IPS'90 sponsors.

We also want to take the opportunity to thank all wonderful people who helped us in the making of the Boundless Planetarium: Delegates and other participants, performers and exhibitors, collaborators and staff members, members of the Organizing, Program and International Committees, sponsors and patrons, and finally the 1986 IPS Council, which dared to give us the task to arrange the conference.

We now hand over the relay-race baton to the organizers of IPS'92 in Salt Lake City, Utah, USA. See you all there!

Lars Broman  Mariana Back
The Boundless Planetarium

Lars Broman and Mariana Back

The Boundless Planetarium turned out to be a most appropriate theme for the Tenth Biennal International Planetarium Conference. It got a flying start when close to three hundred participants from twenty-two countries experienced the Audio Visual Imagineering's specially composed lasershow in the Borlänge Technicon Valley on the theme The Boundless Planetarium.

Many of those who “flew” had never seen a show of this kind and even those who had could definitely see that the McCulloughs are at the frontier, creating laser programs.

We had great fun at the reception and this was a sign that we with confidence could look forward to the rest of the week.

The week framed by the welcoming reception and the concluding marvellous Space Ballet Performance was a filled program. The conference took place at Galaxen Convention Center in mid-town Borlänge and was comprising a delicate balance between the arts and the sciences.

The formal business began with the official opening on Monday morning July 20 when the Dalarna county chief welcomed us all. Astronomer Hans Jorn Fogh Olsen from the University of Copenhagen held the opening lecture. The theme of the lecture was Popularization of Astronomy. Hans Jorn stressed the importance of educating the general public. He also presented some philosophical aspects on our appearance in space. He gave the audience a couple of questions, hard to consider, like if we would board a spaceship if we got the opportunity. (Later, we offered HIM a ticket to Mars and he joined the tour from Kosmorama to Mars with spaceship Aniara on Tuesday evening.)

During the opening ceremony, the close to twenty exhibitors had their last chance to finish the set-up of their exhibitions. For four days, they then presented a nice cross-section of planetarium equipment and astronomy items: Large and small planetarium projectors, lasers, computers, star finders, T-shirts and old books exemplifies the variety of this important addendum to the conference.

The day continued with a cherished plenary session featuring two dozen (!) speakers, reporting from the boundless planetarium scene. It included national and regional reports covering the earth from Japan in the east to USA in the west and from Australia in the south to Scandinavia in the north. Then followed reports on the activities of...
several IPS committees, including among others, the History, Astronomy, Language, Finance committees.

The afternoon plenary session featured just one speaker, Richard M. West. His lively presentation of the European Southern Observatory at La Silla in Chile made us all wanting to visit the place.

West's lecture was followed by the first paper sessions, running three in parallel. A total of over fifty papers were presented during Monday afternoon and during the Wednesday and Thursday sessions. They were generally of high standard and arouse much interest. Many of them will be included in the Conference Proceedings, presently being edited.

Not all lecturers were that serious. Our Monday dinner speaker Jan Erik Bergh from the Sv. Institute of Tech., turned out to be a phoney professor. His His stand up comedy act was unbeatable and very appreciated. One (1) delegate though, who had looked forward to increase his knowledge about Black Hole Education, claimed that he was disappointed. We wonder...

Professor Bergh unfortunately disappared in his black hole generator. He reappeared however just as mysteriously in the evening. We saw him dancing both “Små Grodorna” and “Karusellen” together with the other IPS'90 delegates. All of us were happy to celebrate the lovely summer night in the traditional Swedish manner, rising the Maypole while the fiddlers were playing folk music tunes.

Tuesday was largely devoted to Dalarna. Six buses running in an intricate pattern through this typical Swedish countryside, brought the delegates to a number of interesting spots.

Ancient Falu Copper Mine was visited as well as the home of the reknown 19th century painter Carl Larsson - his house has inspired Swedish home decoration ever since the turn of the century.

In the mid-seventies it was finally proven that the strange circular geological formation Siljansringen was created by a large meteorite who hit the ground 365 million years ago. The formation was watched from the high view point Siljansnas and from the deck of the 100 years old ship Gustaf Wasa who took delegates on a tour on Lake Siljan.

Tuesday dinner speaker was Dainis Dravins, a real astronomy professor from Lund, who gave a pedagogical and inspiring lecture on present and future European space research.

Following the dinner, in-house Futures' Museum invited all participants to the first of two evening open houses. A sudden thunderstorm all but wrecked the world's premiere of the English spoken planetarium show Aniara. The competent technicians of Kosmorama Space Theater managed to get the computers running again, much to the delight of the visiting planetarians and to Mrs.Ingrid Martinson with family. The widow and the children of the late Nobel prize winning author Harry Martinson were specially invited. Harry Martinson wrote the poems on which the planetarium show was based.

A very important event on the IPS'90 Conference was the solemn moment when the runners for peace and ecological relay visited Borlänge on their way from Kalingrad to Le Hague. Planetariums in cities they passed became milestones for the 76 runners. Since a big international sports event for young people did take place in Borlänge the same week as the Conference, we had arranged the Ecological and Peace relay event together with them. The runners stressed the importance of great strains for a better ecological situation. It is our common responsibility to do something to put attention to what is happening to planet earth.

Thursday was the last day of the Boundless Planetarium. The morning begun with Regional Meetings (see separate report of the minutes for NPA). This was followed by an IPS Business meeting. The themes of the parallel paper sessions this day were Didactics, Innovations and Planetarium Management. In the afternoon Prof. Dieter B. Herrmann took the floor and gave an authoritative presentation of planetarium history. During the official closing of the conference, Von Del Chamberlain asked everyone welcome to the next IPS Meeting to be held in Utah, USA.

History became alive later in the evening, after the closing of the IPS'90 Conference, at the Banquet in Stora Bjorn. Suddenly Tycho Brahe himself showed up and held an applauded speech where he announced that he was happy that planetarians tried so hard to keep his description of the solar system alive.

The Grand Finale of the stay in Borlänge was the Space Ballet Performance. Also this program is built on the poem collection Aniara. The performance was special composed for this occasion and some of the
music written specially for this evening. The conference did not only get a flying start. It got a flying end to.

The week had passed, new friendships were made, old friends had met again. Many of the delegates had decided to join the Post Conference tour to see the Stockholm Globe, the National Science Museum of Natural History, the Wasa museum, and to have a lucheon buffet at the Stockholm City Hall. Then, they continued to see the Heureka Science Center in Vantaa and experience the total solar eclipse on Sunday morning in Helsinki.

THE WHOLE UNIVERSE OPEN TO EVERYONE
Hans Jorn Fogh Olsen

During my stay here at Borlänge I have been given the advantage of staying at the swedish countryside in a cottage close to a small lake and far from any neighbours. In such a place one have the opportunity to follow the true nature and all of the Universe visible to ones naked eyes. We, astronomers and planetarians, are not satisfied by watching the sky with naked eyes.

Astronomers are hunting for larger and larger telescopes, equipped with more and more sophisticated electronics, being able to look far out into the Universe. We now have good information about the Universe many billions of light years away or maybe I should say many billions of years back in time. Almost everybody believes that we are close to see the limit of the visible Universe. Maybe Hubble Space Telescope will help us doing this. At least we know for sure that Voyager 2 have finished the main jobs by giving us excellent pictures of planets and moons as far away as Neptune.

But when the astronomer is facing the problem of showing the general public the stars through a telescope, people expect to see what they have waited for so long. Through the telescope people wish to see the Universe magnified, to see the world which they imagine belongs to astronomers. Many has left the telescope disappointed because the stars were still a single dot, now in a small field of view. People do not understand that the only thing they achieve by using a telescope, is to receive more photons, than without a telescope. They do not get the expected magnification of what they see outside the solar system. It is very difficult to understand the unusual distances in the Universe.

People always simply have to believe what the astronomers tell them about the Universe. But do people believe?

For planetarians everything is much easier, they can choose what they want to show. In a planetarium you always show a brighter star larger than a fainter one although you know better.
In the planetarium we play with illustrations which is so far from reality that it could be open for discussion whether you should utilize them or not, but you may choose what you want as a planetarian.

**People always simply have to believe what the planetarians tell them about the Universe. But do people believe?**

Of course people believe in what you tell them, but always remember that they consider you being in the position you are, astronomer and planetarian.

In astronomy we are dealing with science which belongs to every one. You can hardly find a person who have not had the possibility of giving thoughts to what he sees in the sky day or night. You can think of modern amateur astronomers with large telescopes, but you can also think of poor people or soldiers during the war. We are all part of the same Universe every day.

Some people may not even know what is going on in the rest of the world, I mean on planet Earth, but they know the stars and they have usually formed their own model of the Universe.

I can hardly surprise you at this point but only remind you about what we all know from school children. They may not have had much information about astronomy in the school but most of them have made their own opinion about heavenly observations:

Why is it hot in summertime and cold in wintertime?

They give the obvious answer that we are closer to the Sun during summer.

I shall not continue this known subject very long, but also remind you about the question of nuclear power where many people have the opinion that we should try to avoid it. Maybe they are correct, but we must still remember, that the only real energy source is the Sun, so we have to live with nuclear power but utilize it in the most efficient and safe way. For grown up people more complicated questions may arise. They have often created their opinion about questions concerning a limited or unlimited Universe and about limitations in their own life.

Let me create you a spaceship without limitations and invite you all to participate.

You will find everything on board and if you think you will need something more, just ask before take off and you will get it. You will have to work there, but you can also have your house and garden and do your favorite sports and hobbies: sailing, golf etc. The spaceship is large enough for you to bring your family and select your friends, and it is large enough to avoid meeting your enemies every day. There only exists one problem, we will never return to Earth.

A quick survey showed that only half of the audience wanted to participate. I have often asked this question among others and a lot of people do not want to participate, probably because they are either scared by new undertakings or pleased with life on Earth or both.

Mariana Back reminded us about the fact that all from the audience will emigrate with spaceship Aniara. After that splendid performance, I am sure many has changed their opinion.

**FÄRDBILJETT**

Enkel resa, Mars Emigrant nummer: 00074
från: Kosmorama R 1
Pris: 10-25 # #
Rymdskyttel : Aniara

Realize that we are all travelling with spaceship Earth, and they may not have thought of the possibility of orbiting a star to solve the problem with energy supplies.

Since very few are really interested in the unlimited travel with a spaceship, even under favorable conditions we may expect very few travellers.

When we want more information from space we might want to send out robots. How should they be created to meet all kinds of requirements for unlimited spacetravel.

Since we can not expect them to function during the whole journey we would try to implement facilities like:

- Auto repair of minor damage.
- Auto reproduction in a controlled way.
- Teaching of new robots followed by a productive life.
- Reuse of material from old robots.
- Etc.
If we continue along this line we will very soon find that human beings fulfill the requirements to robots useful for spacetravel, except that they should be interested in the surrounding Universe and they should be interested in travelling in space. But of course....
At this point the audience may feel that I compare them with robots, but robots similar to human beings, with the prime goal of invading space.

None from the audience could accept to be considered as robots. That was an unusual result compared to my previous investigations among audiences from the general public, where a large percentage usually didn't mind to be considered as robots as long as they can be what they are now.

If we are robots the whole Milky Way can be filled with species like human beings and they can be distributed from a single point in the Milky Way within relatively few millions of years, a fairly short time compared to the age of the Milky Way.
The question can not be answered until we get knowledge about intelligent life somewhere else in the Milky Way.

The problem for us, astronomers and planetarians, are to give serious information about the Universe.
As I see it, you can choose to do it in at least two different ways.
You can choose to present all new scientific results straight from scientists.
The general public will be impressed by all these fantastic results, including a whole new world of words which is difficult to understand:
Black Holes, Neutron Stars, Dwarfs, Giants, Light Years, Big Bang etc.

You know this is done in many cases because you get in return as astronomer and planetarian many questions like:
I saw a program in television about Black Holes. That was fantastic, but I did not really exactly understand everything. I am sure you can explain that?

Why does people ask these questions about the Universe. They never ask such complicated questions about the TV-set which brought such news. They simply just use their TV-set.
So the problem must be that they cannot simply just use the given information to anything else than being impressed.
So even if you have a bright idea of how to present a Black Hole in the planetarium, please do this, having in mind, that the people receiving such information must also be able to include it in their own universe. A universe which we very often know very little about, so it is difficult to meet these requirements.

Later at the conference Jan-Erik Bergh showed us in an excellent way how a Black Hole can be presented in a way everybody understand. I wish he would have been present in this Universe to see how much we appreciated that presentation.

On the other hand if you prefer to avoid the more complicated explanations and take a starting point where you expect that the audience can follow you, there are really a lot of subjects to explain: seasons, solar activities, day and night, different types of stars, galaxies etc.

Do not try to push. Make sure what kind of common knowledge you may expect. If you look at the school curriculum in astronomy in your country, you and other teachers may not find much advice, about which background you can expect.
Just to give you one example from a high school curriculum. It simply tells to teach in: Stellar constellations and cosmology.
It is not obvious to me what they learn under these headings. Very often it is on a more theoretical background because modern school system does not allow time for children to get out in darkness to get a confirmation of what they were told, mainly because of heavy light pollution in the populated part of the world.

We have an important job to do when we teach astronomy to the schoolchildren and the general public.
We must connect the modern scientific world with everybody's cultural background.
You may find this background in all directions of scientific, religious or astrological directions.
Which direction they have chosen does not make any difference.
If you tell them that they are wrong in their choice, and that is very easy, they will never believe you whatever you tell them about astronomy.

But as I said earlier keep telling about astronomy but in a simple way, because so many have empty space for astronomy in their cultural life. It is needed, and it is well received. They may even believe in subjects where they have to trust you, when you start to talk about the more complicated scientific items.

Every one does there own speculations, but they still need more facts to build a reliable picture of the Universe. Because everybody do their own speculation they may end up far away from reality.
You cannot force people to believe in everything you tell,
but you have a great advantage, you can tell them a lot of things about the future and you can be sure that it will be fulfilled.

Let me just remind you about the solar eclipse next Sunday, which is a prophecy all believe in, because astronomy have a good reputation.

Not all sciences are so successful. Meteorology do their best but they cannot guarantee a clear sky to make sure that you will see the eclipse.

I wish you success with the eclipse, but in case not, I am sure you will spend the time during the eclipse looking back to a successful meeting here in Borlänge.

PS: I happened to see the eclipse from an aircraft, but I understand that successful observations were also done from Helsinki during the solar eclipse of July 22, 1990.

ECOLOGICAL PEACE RELAY "BALTICA '90"

Javgeni Joukov

Borlänge, the 19th of July 1990

Dear Ladies and Gentlemen,

On behalf of the Soviet Peace Committee and the Dutch Association "Sport & Vriendschap" and all the participants of the relay for Peace and Ecology "BALTICA '90-NEXT STEP", let me congratulate you with the 10th European Conference of the Planetaria and wish you a successful and productive ending of this conference!

"BALTICA '90" has been organized by the Soviet Peace Committee in cooperation with the Dutch Association "Sport & Vriendschap". The route of the relay goes through the Baltic Soviet states, Finland, Sweden, Denmark, Germany, Belgium and the Netherlands. It started in Moscow at the 7th of July and it will finish in the International Peace Palace in the Hague (NL) at the 26th of July. The participants of the relay come from the USSR (Russia, Ukraine and the Baltic Republics), Belgium, Germany, the Netherlands and Czechoslovakia. Along the route, many people and sportsmen join the relay.

The main objectives of this event are the following:

a) struggle for environment and peace by a joint effort of everybody for saving our small space ship 'Earth';

b) relocation of financial and logistical means from military programs to ecological reconstruction of our environment;

c) support to the idea, that without the participation of each individual, we will never solve the task of the ecological reconstruction of our planet;

During the relay, we try to realize these objectives in the following way:

1) Meeting grass-root and governmental ecological organizations and movements in the countries we are passing through;

Creating and strengthening linkages between environmental organizations by functioning as mediators in the programming of mutual research and action-work;
2) Measuring the level of radiation along the route of the relay. Taking water-samples of the Baltic-Sea and checking the presence of phenolic components in the water;

3) Motivating people we meet on the way, exchanging ideas about the state of our state of our environment and how we can change for the better, seeding seeds of responsibility and understanding for our common environment and our next-door neighbor;

4) Composing an inventory-report about the results of our research during the relay.

During the first part of the relay from Vilnius to Stockholm, we managed to collect the following preliminary results:

1) the level of radiation along the route is generally normal (0.008 < X < 0.018 Roentgen/h.). Only occasionally, the level of radiation was more than 20 MRöntgen/h but never exceeded 28 MRöntgen/h. The level of radiation in Borlänge (dd. 18/7/90) ranged between 8 and 10 MRöntgen/h.

This means, that situation concerning the radioactivity along the Baltic states according to our measurements is well.

2) Concerning the pollution of the Baltic Sea, the results show existence of rather high levels of phenolic compounds. However, further research is necessary!

We thank you for your attention and we hope that you will have a fruitful continuation of this interesting and inspiriting conference. Thank you,

A sportive salute from the runners of the international ecological peace relay "BALTlKA '90-NEXT STEP", in name of

Doctor Jevgeni Joukov (USSR) and Ir. Bernd Schrikkema (NL)

The sponsors of this the relay "BALTlKA '90", are:

Krivoy Rog Steel plant Ukraine USSR;
Moscow Planetarium;
International Consortium of the Ecological Reconstruction (Russia) and RAF-automobile assembly-plant of Riga, Latvia
Holland Computer Import LAN-systems, Rotterdam, the Netherlands

THE PLANETARIUM HISTORY - ASPECTS OF TECHNICS AND DRAMATURGIE

Dieter B. Herrmann

No other science created such a impressive, instructive and liked instrument for popularization like astronomy with the planetarium.

Attempts to demonstrate the perception about univeris with the help of models existed already in the antiquity. But we hused only apply to modern projection-planetarium like it is widespread and produced by different firms in Germany, USA and Japan.

The suggestion for the development of an instrument that can imitate the firmament gave the German astronomer Max Wolf. This idea found the active interest of the founder of the German Museum in Munich Oskar v. Miller. This man could warm up the firm Carl Zeiss for his intention. World War I prevented the project. Besides it don't exist a guiding idea. This idea came from Prof. Walther Bauersfeld, a member of the managment of the firm Zeiss, in March 1919. He suggested that all movings in the sky should be produced by a system of projectors. The projectors would generate their pictures in a darken hemisphere. The main idea was the following: The gearnings for the movement of the planets personify a heliocentric solar system and so they can reproduce in projection the geocentric relations.

It took the next five years to compute and realize the basic idea.

It was in the summer 1923 when the artificial sky of the Zeiss-planetarium was demonstrated first time with a 16-metre-cupola at the firm area. Then the instrument came to the German Museum in Munich and was shown by Bauersfeld under a 10-metre-cupola. A second instrument with the same construction was built up in Düsseldorf in 1926. Later it found the definitive place under a 12-metre-cupola in Den Haag. The first so-called Zeiss-types I were detailed described and I can renounce to give more information.
The first Zeiss-planetarium was able to demonstrate the following:

- Constellations
- Milky Way
- Names of the constellations
- Sun
- Moon and the phases of the moon
- Motion during a day (3 speeds: 50 seconds, 2 minutes, 4 minutes)
- Motion during a year (7 seconds, 1 minute, 4 minutes).

It took not long time till it was decided to improve the first type. Dr. Walther Villiger guide the works. He was the director of the department for astronomical instruments and the planetarium at Zeiss. Now it was possible to show the view at sky and the motions of the celestial bodies for every latitude. The type I could only demonstrate the view for a fixed latitude. The transition to such a universal instrument caused radical constructive improvements. The eccentric position of the star-projectors demanded a possibility for adjustment and star slides corresponding to the diameter of the cupola. Bigger extensions led the common diameter between 20 and 23 metres. The possibility for the demonstration were extended:

- Sirius as a special-projector
- Colored bright stars
- Nebulas and star clusters
- Demonstration of the precession and a scale for reading
- Sun with aureole and counterglow
- Aequator, ecliptic, sector of the mark of the pole
- White and blue light in the cupola.

The second type allowed a more realistic projection of the sky and the mediation of knowledge that was not close connected with the direct view, for example, the astronomical co-ordinate systems. The philosophy of a program that followed from this situation was the mediation of knowledge in the sense of the instruction.

This was continued with the creation of some novelties at the Zeiss-planetarium. As well additional projectors as new functions on the instruments aimed at a better visual instruction.

Villiger described the following novelties that was inspired by the philosophy of the teaching planetarium in 1934:

- Comet light for the horizon
- Sun for the representation of the nautical triangle
- Optical reading of the latitude

The orientation on the classic instruction is evident in the literature for the using of the planetarium. The Jena teacher Deinhardt published a paper with the title "Das Zeiss-Planetarium im Dienste der Himmelskunde für Volksschulen" ("The Zeiss-planetarium on duty of the school-astronomy"). This could be the first attempt, to give a instruction for the using of the planetarium for poor education. The teaching program for the eight-class-school by Deinhardt contains concrete recomends, examples for teacher performances and brings the "Lehrplan für Himmelskunde in den Volksschulen Jenas" ("scholl curriculum for astronomy in Jena").

The planetarium got the central role. The school performances were hold with pedagogic point of views. (Deinhardt, 1934)

A further drastic change of the performance was (later) involved with the development and use of additional technique that is loosed from astronomical contents. Shootin star-projectors, solar system-projectors, polar light, and similar show effects have a direct relation to astronomical contents, but with a laser show or multivision no direct relation is given. The combination of this technical aids with refined acoustical and musical effects led to a qualitativ novel representation of artificial effects and pure show effects. Here a clear decision is necessary that last not exist during the first years of the planetarium: What do you want to aim with the representation? Poor Show, entertainment and commerce or deep problems and results of scientific researching work stand in the first place? While the classic planetarium give no alternative to the mediation of astronomical knowledge, the new planetarium can remove far from the original intent. This development opens chances and dangers. In extreme case the planetarium can used complete alienated. That is the danger. But it exist the chance that the results of science could be a deep event for the visitors with a successful connection between fascination and wealth of ideas.

The way to the dramaturgy of the modern planetarium was essential influenced on the introduction of the automatic steering of the program. So it is possible to use the effects dramaturgic considered and temporal exact with precision or to work with many simultaneous and compact events. The automatic steering causes the possibility for a repertoire of different programs that lead to a varied arrangement. (Herrmann, 1990)

The dramaturgy of the classic planetarium corresponded to the dramaturgy of the real proceedings in the sky. The constellation and the movement of the celestial bodies were the contents because this is the essence of classic astronomy.

Bertolt Brecht referred in his theoretical papers "Die Dramaturgie im Zeitalter der Wissenschaft" (The dramaturgy in the age of science) to the demonstration of natural proceedings in the planetarium. He wrote: "The new type (of theater) shall be com-
pared with the all-known institution for astronomical demonstrations, the planetarium ... Before claiming for dramatics a P- (planetarium)-type / we have to draw attention to the borders restricting mechanics, which are becoming more and more obvious. When in planetariums the regularity of the motions causes more differences between the instruction of the guests. Of course the early systems could only reproduce the astronomical knowledge till about the middle of the last century.

It was not possible to show the new scientific knowledge that arose out of astrophysics, to illustrate how researching work opened new distances, discovered the galaxies and their distribution. Only when additional projectors, special effect-projectors, multi- vision, all-sky, zoom-technique and projection of moved pictures were used, it could given a more complete picture of astronomical knowledge. The technical apparatus causes more differences between the demonstration and the natural imitation of the sky. This follows from the fact that a view at sky shows not the essential of the universe.

It shows only a reflection. On a theoretical standpoint it is clear that the mediation of modern astronomy is only possible, if we leave the classic natural demonstration. Things must be showed in a modern planetarium that are not to be seen with naked eyes. Also things must be showed that no astronomer ever saw with the help of optical instruments, for example the development of a star to a red giant or the evolution of the universe. So the new technical possibilities of a planetarium are a direct consequence of the development of astronomy. And the new dramaturgy is a consequence of both the-new astronomy and the modern technique in the planetarium. On the other hand the program will become attractive and effective for the guests. So we touch a question that is connected with the working style of the planetarium. An attractive program is a good supposition to propagate qualitative the idea of the planetarium.

The exposed ideas about the historical way of the planetarium from a teaching instrument to the star theatre are contain in 3 remarks that were given by well-known astronomers and journalists. They were given during a space of about the 10 years between 1939 and 1949.

The most of this remarks could only be understood as a vision. No technical possibilities existed at that time, but the insights of astronomy were on a quite different and higher level than the classical astronomy.

The Dutchman B. J. Bok was for an effective and intelligible mediation of astronomical knowledge. The professional astronomer should appreciat this:

There is nothing to be said against a certain kind of dignified propaganda, and professional astronomers should not for usual look askance at a director of a planetarium who attracts the broad public by dramatic popular performances. On the other side, it is good to emphasize that impressive performances should be objectively right. The public will not be longer interested in the presentation of scientific methods and results if the principles of scientific truth will not be taken into accurate consideration. (Bok, 1939)

The mention of Bok that the dramaturgy can not curtail the scientific correctness is right up to our days.

After World War II the Swedish astronomer Elis Strömgren and the journalist Wolf Durian argued for an artistic performance. This means a new quality for the technical use of the instrument. Strömgren said:

The writer of this lines does not doubt that the main centres of culture will have - sooner or later - their planetariums. Never before a visual aid so instructiv as this one, of such charming effect had been created applying to the same extent to all. An aristocratic instrument being in its effects more democratic than anyone else. It is school, theater and film at the same time, a class room under the firmament and a drama, where the celestial bodies are the actors. Of course, the person who offers this subtle piece of art should have phantasy on its own and astronomical education reaching far beyond the elements. Here may be, we have the Achilles' heel of the planetarium-idea. (Strömgren, 1947)

And Wolf Durian said 1948:

Astronomy: that's it for what the planetarium had been built, but should the science of stars made known in such a scholastic an dry way, here in the palace of stars? Then we might as well come together in a painted class room. The kind of astronomy that should be taught here should rather bear the spirit of stars. Great scientists and poets should lecture and recite
here. There are experts on stars who are poets. The listener and viewer wants ... to catch sight of the remoteness, eternity and timelessness. That means inspired astronomy and figures, transmitting conceptions and ideas. Everybody should know about the hour under stars, the one from yesterday and the one from tomorrow. (Durian, 1942)

The transition to the modern planetarium is described very clear, but only in the ideal starting point. The intention of the authors is the mediation of extensive connections and not a poor mediation of knowledge. They recommend the use of artistic means to reach this aim.

Nobody spoke about the extension of the technical level.

The statistic shows that only some years after this statements a world-wide boom of planetarium foundations begun. This was without any similar example up to this days.

A cumulative representation of the overall rise in the number of planetaria on an international scale as a function of time, counting all sizes alike, is particularly revealing. The graph show that the number of planetaria founded during the first 25 years after the invention grew slowly and - on average - steadily by about one planetarium per year. Most of these were large planetaria, and the majority of them were supplied by Carl Zeis Jena. After 1951 there was a phase of increased activity, with an average of eight establishments per year. From 1969, the number of planetaria worldwide increased enormously. By 1987, the end of the period studied, an average of 42 planetaria were founded per year. An analysis of this time span, during which planetarium spread most rapidly, revealed an exponential rise between 1961 and 1970, small and mediumsized planetaria have a large share in this development.

Concerning the subjects of the work on planetaria during the recent phase (since about 1961), the characteristic trend in the development of a planetarium-internal "user philosophy". A dramaturgy for planetarium shows can be seen to have evolved, which is - especially in case of the large planetarium - increasingly subject to the requirement of combining educational and instructive elements organically with emotional and entertaining ones. Artistic presentations (language, music, graphics, special effects) are gaining in importance. The quantitatively most active phase of planetarium propagation in general, then, is evidently connected with a qualitative change in program production.

The role of music as a component of the program needs attention. Original the music came for practical reasons into the planetarium. The time of dusk, that is necessary for the adaptation of our eyes, was bridged with music. Besides the music has a psychological reason. It focuses the attention on the mediation of knowledge and concludes the performance.

The application of music during the program is quite different. There is no doubt that mediation of knowledge, valuations and attitudes is the main aim of the planetarium. If we accept this standpoint we can give the music only one role: It is submitted the dramaturgy. The music in planetarium has no independent function.

Theorists argued for the connection between the optical demonstration in planetarium and the music: "The one-sided deep adaptation of the eyes ... must have a counterpart in an acoustic impression." (Thiel, 1981)

Music in planetarium is a functional music. For example Eggebracht defines a music with the sign "that it is refer to a fixed function (task, service): music that comprehends and is comprehended for production or reproduction is in essential dependence from the concrete aim in fulfillment of a work." (Thiel, 1981)

Principle we can elect every music for the planetarium. It is clear that we must ask to the connection between music and treated matter, projection and intention. The same demand exist, if a composition for planetarium is created. The intention should not be a close frame for the music, but it should aspired after a clear reference to the dramaturgy of the program in the artistic statement and the course of time.

With this basic position new possibilities will be opened for music in the planetarium. But the practical work looks like different. It seems that many creators of the programs have no principles for the using of music. On the other hand clichés arised that are in contrast with the aim of the performande.

Already the composer Hanns Eisler demonstrated this clichés in his book "Komposition für den Film" that was written in 1942. In this connection he speaks about "Kartothemusik".

Eisler references are very interesting, because the recurrent effects occur in the planetarium. This effects are susceptible to the clichés: dusk, movement of the day, projection of the planets and a finite number of special projections.

The film-music-research showed, that two musical sorts of connection between optical demonstration and music exists: the exclusive emotional influence on the spectator and the sort, that demands a rational perception, because it aspire to a contrary cooperation of picture and music, therefore music and performance in planetarium. Already in the both cases dramatic and dramaturgic independent film-music was demanded. But this was not aimed at a doubling of the visual and rational statement.
In this respect a great danger exist in the planetarium. There the demonstration is only aimed at the mediation of knowledge, with it's integration and valuation. The emotional component has to subordinate. Music-psychologists warn that the use of music causes "in place of a critic rational attitude a emotional opinion" at the spectator. If we held the motto "Birdie sings, music sings", than we support this tendency.

Big significance has the technical level of the instruments for the reproduction of the music. A intensive expense is necessary if this instruments shall keep step with the technical level of the complete planetarium. We should aspire to room-sound effects, moved sound-effects and separate canals for the speakers. It is clear that the acoustic level interact with the possibilities for dramaturgy.

Ladies and Gentleman
The planetarium developed from a teaching-instrument to a magic machine in the 70 years of its existence. The creation of the new technical instruments and effects led to a change of dramaturgy and the modern star-theatre.

We should be at one: human being and stars, structure and development of the universe, variety of its objects, methods of the researching work - this should be the purpose of our work. Never the original intention of the planetarium should be only an accessory. Than the variety technique and the intensive effort make a sense: to informe, stimulate and inspire more and more people for the world of science.

Acknowledgements
Many thanks to Dr. L. Meier (Zeiss Jena) for some material about the first beginning of Planetarium construction in Jena and to O. Schwarz (Eisenach) for the translation from German into English.

Literature
Deinhardt, O. (1934). Das Zeiss-Planetarium im Dienste der Himmelskunde in Volksschulen, Carl Zeiss Jena 1934


Many thanks to Dr. L. Meier for his material about the main functions of the first planetarias.
COLLABORATION BETWEEN EUROPEAN PLANETARIUMS

Agnes Acker

Organized as a joint venture by the European Joint Committee on Scientific Co-operation of the Parliamentary Assembly of the Council of Europe and the Planetarium of Strasbourg, the first European Colloquy was held at the Council of Europe Headquarters, Strasbourg, from 7-8 May 1984.

The participants, approximately 120 in number, drawn from 15 different countries within Europe and from the USA, came from professional institutes, research establishments, universities, Planetariums, observatories and astronomical societies, in order to exchange experience on the use of the Planetarium as a means of presenting and teaching astronomy.

This meeting laid the foundations for much better collaboration among European Planetariums: "young Planetariums should be helped to get started; mutual information about new techniques or materials must be shared; programmes could be prepared together. To this end, a "Working Group" has been created within the "Committee for Science and Technology of the Parliamentary Assembly of the Council of Europe". Each year an Information Bulletin is published with the help of the Council of Europe too.

The Second Colloquy of the European Planetariums was held at the prestigious "Cité des Sciences et de l'Industrie" at Paris-La Villette, from 6-8 May 1988. The Third Colloquy is planned in May 1992 at the European Southern Observatory, Scientific Center, Garching, and at the "Deutsches Museum" in Munich (FRG).

Other European Conferences take place such as:
- the annual meeting of the "Allgemeine Deutschsprachige Planetarien";
- the annual meeting of the "Association des Planetariums de Langue Francaise" (French Language Planetarium Association);
- the European Conference, organized in 1988 by Dr Simopoulos (Athens);

ORGANISATION OF EUROPEAN PLANETARIUMS COLLOQUIA

The first colloquium was held in Strasbourg in the walls of the European Council from 7 to 8 May 1984.

The second one took place in Paris at the Cité des Sciences et de l'Industrie de la Villette from 6 to 8 May 1988.

The third colloquium will be organized by the European Southern Observatory and take place from 7 to 8 May 1992 at Garching near Munich (FRG).

"THE EUROPEAN PLANETARIUMS NEWS" - Annual Information Report

It will permit a better exchange of scientific and technical information

PLANETARIUM SHOWS FOR EUROPEAN PLANETARIUMS

Shows will be constructed on an astronomic or scientific subject

A story-board is written adapted to the equipment of the different Planetarium types in Europe; (e.g.: the Planetarium of Strasbourg supplied the Planetarium of Bochum (FRG) with a show-box treating about the subject "time") ; meetings of specialists (galaxies, cosmology, space,...) will permit to improve the quality of the information.
PARTICIPATION AT THE EUROPEAN ACTIONS FOR A SCIENTIFIC DIFFUSION OF HIGH QUALITY

e.g.:
- Summer 1989 : the International Space University in Strasbourg (lectures, visits of the main research centres of the region, Planetarium shows, seminars, etc.)
- Autumn 1990 : a big itinerant exhibition on astronomy, the means and the results - presented by the European Southern Observatory, in Strasbourg (European Council).

CREATION OF A DIPLOMA FOR SCIENTIFIC ANIMATION

A very best teaching on theoretical knowledge, including the methods and limits of the Research is proposed to the students thanks to the participation of famous scientific personalities from all over Europe. Practical training courses will be planned to take place in several European research institutions.

REFERENCES
Compte-rendu du Deuxième Colloque des Planetariums Européens (1988)

UNIVERSITE DE STRASBOURG I
<CENTRE DE RECHERCHES TRANSDISCIPLINAIRES SCIENTIFIQUES & TECHNIQUES C.R.T.S.T.>

DIPLOMA OF UPPER SCIENTIFIC STUDIES

"Scientific and Technical Communication"
(Master's degree)

The scientific and technical communication is developing in many fields in France: managing and animation in the museums and Planetariums, journalism and TV-radio reports, teaching and itinerant exhibitions. In order to permit the best recruitment of efficient mediators for existing or in pass to be created jobs, it is essential to plan education programs and training courses adapted to the scientific and technical mediation.

CONDITIONS FOR ADMISSION

This education program is intended for people with a scientific formation (A-level +5):
- Museums and Planetariums: managers (financial and organization, scientific and technical animation).
- Journalism: scientific journalism (press and TV).
- Teachers: school professors and teachers specialized in the scientific animation.
- Sectors of "communication" within the commercial societies.

ORGANISATION

The duration is of 650 hours a year.

The diploma of upper scientific studies will be structured as follows:
1. General culture in Science and Technics
2. Epistemics and Anthropology in Science
3. Techniques of mediation in Science - Utilisation of data centres and scientific documentation - video, holograms, treatment of images, ...
4. Financial organization and knowledge, Law and Economy
5. Training courses

Only professional (French and European structures, museums, press, etc.) personalities will dispense the teaching.
This diploma is aimed to give all those who work or intend to work as operator in a Planetarium a basic formation both theoretical and practical, in order to diffuse the scientific knowledge and especially the astronomical information in the best way.

CONDITIONS FOR ADMISSION
- A-level
- Special examination of candidates who have an insufficient level

ORGANISATION:
The duration of the formation is 140 hours (four weeks of five days over one year) with a possibility of extension on two years.
The three first weeks take place at the University Louis Pasteur of Strasbourg. The fourth week is a practical training in a Planetarium of France or Europe (e.g. the Planetariums of La Cité des Sciences et de l'Industrie, and Le Palais de la Découverte at Paris ; the Planetariums of Strasbourg, of Tregor, of Stuttgart (FRG), ...)

In 1990, 17 French and 1 Italian students passed the diploma [practical part in France, and Germany, (Stuttgart) for 3 of them].

COMPLEMENT:
Workshop "Highlights in astronomy"
A workshop will take place each two years, during 3 days, in the local mountains (the Vosges), under the leading of famous scientific personalities.

Planetariums are actually quite young in Nordic Countries i.e. in Denmark, Finland, Norway and Sweden. The oldest still active planetarium opened in 1969 in Tampere, Finland where I come from.

In 1985 there were about 30 planetarians in a symposium in Tampere. There we decided to establish a Nordic Planetarium Network with Lars Broman as coordinator. Last January this organisation was changed to the Nordic Planetarium Association.

Five years ago there were only three public planetariums in Nordic Countries. One was in Tampere where we have a Minolta projector and 13 m dome. In Lund, Sweden was another one which opened in 1978 with a Goto projector and 6 m dome. The third one was a mobile planetarium in Gothenburg, Sweden. This planetarium with a Starlab projector and 4 m dome was founded in 1983. In addition there were 8 portable or small planetariums which were not open for public.

During the last few years there has been a big rise in planetarium field in Nordic Countries. It started in 1986 when the Kosmorama Space Theater opened here in Borlänge. This planetarium has a Spitz projector and 8 m tilted dome. In the same year the Mobile Planetarium of the Amateur Astronomical Association Ursa started to operate in Finland with a Goto projector and 6 m dome. At the same time started a very active portable planetarium with a Goto projector in Kinnula, Finland. In 1987 a Spitz projector was installed in Karlskrona, Sweden.

Last year started the Verne Theater Planetarium in Science Center Heureka in Vantaa, Finland. This is the first planetarium to use fibre optics in the starball built by Jenoptik. The tilted dome is 17.5 m in diameter with 197 unidirectional seats. A hemispheric film, special allskys and videos are also used.

In Tromsø, Norway, opened last year the northernmost planetarium in the world. The Northern Lights Planetarium has a Spitz projector, 12 m dome and 90 seats. There is also a Cinema 360 film system. The film called Northern Lights made with special technics is their own production.
Also last year opened Tycho Brahe Planetarium in Copenhagen, Denmark. This is the biggest planetarium and Omnimax theater in Nordic countries. There is a Zeiss projector, 23 m tilted dome and 275 unidirectional seats.

Next year in Stockholm, Sweden, will open a new planetarium and Omnimax theater in the Museum of Natural History. There will be a 23 tilted dome with 325 seats.

Finally in addition to these new planetariums we have also renewed our planetarium in Tampere. We have built an interactive system according to the idea by Terence Murtagh. We have now 161 seats with pushbuttons. The audience can choose by voting what they want to see next. Our system is automated with computers which control video tape players, video disc players, CD rom players, video projectors and an allsky system.

THE BRITISH ASSOCIATION OF PLANETARIA

Martin Ratcliffe

The BAP has continued its support activities, through the Association of Astronomy Education (AAE), for the development of materials in the new UK science curriculum. This core curriculum for all schools in England and Wales, and soon in Northern Ireland, includes Astronomy for the first time as a permanent part.

Closer affiliation with the larger Association of Science Education (ASE) has assisted toward the production of two work packs for primary and secondary teachers. The first, targeted at primary and middle schools (ages 5-10) has been published, and is available for review during our conference in Borlange by request from the writer. The second will be available in the Autumn (fall) of 1990.

The bulk of the work, developing worksheets, teacher trials of the pack and writing of support materials, was carried out by members of the BAP group.

Our annual meeting was held in February 1990 in South Shields, Tyneside. The planetarium there is attached to a nautical training college. We discussed the needs of the smaller planetarium in the UK, tackling the new science curriculum, reviewed plans for the UK National Astronomy Week, and viewed a new Meteosat weather satellite receiving system, MacSat, which runs on a MacIIx, and is proving to be a powerful teaching tool.

Attendance figures at all member institutions is on the increase, largely from schools groups eager to fulfill the Earth and Space aspect of the curriculum.

Membership of the BAP group stands at 17
THE BELGIAN SITUATION

Johan Gijsenbergs

ABSTRACT

Belgium does not have a great tradition in building planetariums. It still runs however one of the oldest planetaria on the continent. For the moment a new planetarium is being build near the east-border of Belgium with means of European Funds. Other regions within Europe can benifit from these funds as well.

INTRODUCTION

Belgium is a small country in the heart of Europe with Brussel as its capital. How small it is however it has three language-regions: the Dutch speaking part of Flanders, the French-speaking part of the Walloons and a German-speaking area near the German border. Within the IPS-directory you would find 4 planetaria in Belgium. Two of them are directly related to a public observatory and a third of this kind is not mentioned. All active planetaria are situated within the Flemish part of Belgium except for the Brussels planetarium which has a bilingual function in the country. Within the Walloons and the German speaking part of Belgium no planetarium exists.

In Flanders the public observatories play a great part in the education of astronomy and related sciences and it is here that we find the planetarium of Antwerp related to the public observatory of "Urania". It houses one of the oldest planetariums ever build. It runs over 50 years for the moment and being part of the Zoo at Antwerp it runs live shows everyday. The Antwerp planetarium is just now showing some technical malfunction and will be replaces by a Skymaster in 1992. With its small capacity it serves more people every year than the National Planetarium of Brussels which too is an old Zeiss planetarium build for the worldexpo in the year 1936 and refined in the early 1960's. Its capacity from 360 seats however in a capital city of Brussels is never been used thorough due to a number of director-changes. Another public observatory related planetarium is that of the observatory of Bruges called "Beisbroek" with a capacity of 40 people. The Home made "Aquila" planetarium can be situated as a personal effort of a enthusiastic amateur astronomer.

The new planetarium being build for Belgium (12,5 meters) is again one with a public observatory within Genk, the province of Limburg in Belgium. Limburg is situated near the Eastern Board of Belgium and only a few kilometers away from Holland and Germany. This place where 3 countries meet one another is called the "Euregio" in the heart of Europe.

The building of this planetarium was only possible through financial means of the European Community (E.E.C.). The Province of Limburg has known a decline of industrial activities due to the closing of a lot of coalmines and the E.E.C. has started a fund called E.F.R.O. which stands for European Fund for Regional Development. It is from the E.F.R.O. that poor regions all over the E.E.C. can benifit from. The list of all these regions would take too long and for the different regions, different rules are in force but principally 50% of all costs are borne by the E.E.C., and that means a lot for building a planetarium.

There are certainly opportunities for other small European regions to do the same and we are willing to help if possible. For building the planetarium at Genk one of the rules is to create a planetarium for the Euregio which means that our programmes will be presented in German and French. In that repect there is little competition from either side. There is certainly
a lack of planetariums at the westside of Germany (Koln or Aachen have none). First one to meet is Bochum and there is no planetarium within the Walloons of Belgium. The first French speaking planetarium from Genk is Strasbourg. It will be our task to provide the Euregion of a planetarium. It will not be an easy one. The "Europlanetarium" as it will be called for obvious reasons will be ready spring 1991. Together with the already existing public observatory the planetarium for Genk intends to popularize other sciences than astronomy. The new planetarium is situated within a recreation area with lots of sports facilities but also with the only existing Geological garden in Belgium. A Geological garden is an excellent extension to an observatory and a planetarium. A Geological garden tells the story of the creation of the Earth by means of all kinds of stones and sites. Together with a farmyard and a solar system-path the Europlanetarium will provide a popular scientific area for the "Euregio".

HIGHLIGHTS FROM THE PLANETARIUM SCENE IN GERMAN SPEAKING COUNTRIES

Joachim Prölls

The German speaking countries cover the region Austria, Germany and Switzerland (partly). In 1977 the Arbeitsgemeinschaft Deutschsprachiger Planetarien (Working Group of German-Speaking Planetariums) was founded. Since 1987 the Rat Bundesdeutscher Planetarien (RBP) (Council of Federal German Planetariums) represents the planetariums in the F.R. Germany.

The RBP is the national organisation for supranational organisations and problems. The council is competent for
- spreading astronomy in schools,
- general problems concerning finances, legal situation, expert opinions and
- public work

It is the partner at the cultural-politics-level.

Statistics of Dome-diameter, Seat capacity, scientific staff,.. are listed separately.

The financial basis comes from the cities or common organisations (Landesverband u.a.).

In Germany the evolution of automatic shows in emphasized, not only for the public but for school-shows too. Entertainment with embedded astronomical facts rises interesting for astronomical topics, comparable with TV-shows. Each planetarium has a different automatic system,
exception: the planetarium in Berlin (West) is installing the Bochum system.
The conception of a planetarium depends on the curriculum for astronomy in schools. If there is no curriculum, i.e. in North-Rhein-Westfalia, the visit of a planetarium with pupils is a private activity of the teacher. This leads to different cooperation with schools.

Members of the Council of Federal German Planetariums

<table>
<thead>
<tr>
<th>City</th>
<th>Dome Diameter</th>
<th>Main projector</th>
<th>Seat capacity</th>
<th>Scientific staff</th>
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<tr>
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<td>1</td>
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<td>Wolfsburg</td>
<td>15</td>
<td>Jenoptic DP 2</td>
<td>150</td>
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</tr>
</tbody>
</table>

There is no program exchange between large planetariums. The small institutions are interested in cooperation because of personal problems.

There is a unique situation concerning two german countries. In the former G.D.R. has been a lot of small planetariums and strong interaction with teaching astronomy in schools. This has led to good astronomical knowledge. We hope this to be an impulsion teaching astronomy in schools in the western part of Germany.
THE PLANETARIUMS IN FRANCE

Agnes Acker

Concerning the Planetariums, France occupied a very bad situation until 1980, with the unique public Planetarium at "le Palais de la Découverte" in Paris, and a private Planetarium in Toulouse, working in a High School in Astronautics. In 1989, the situation has highly evolved.

The "Association des Planetariums de Langue Française" (French Language Planetariums Association), created in 1984 ("legal" existence since 1989), regroups the french Planetarium's managers and operators, and professional astronomers interested in teaching and popularizing of astronomy. Beside France, Belgium, Switzerland and the Federal and Democratic Republics of Germany are also present in our listing because of their french visitors.

As shown on the map (Figure 1) and on Table 1, Planetariums are working almost all over the country. Ten Planetariums with a dome of 6 meters or more, and with projectors such as Spitz (USA), Jenoptik (DRG), and GAP (a new french constructor) work in 1990.

The whole rate of visitors of these Planetariums is of about 500 000 a year. It is a rather good figure always growing up year by year. Concerning the "oldest" Planetariums, existing since the 1980's, none of the operating Planetariums have known important problems such as lack of public. Break downs are rather rare and the used instruments, Spitz and Zeiss, give whole satisfaction and provide high quality and precision.

More or less advanced projects exist: in Bordeaux, Marseille, Lyon, where astronomers of the Astronomical Observatories are working on the projects with the collaboration of amateur astronomers. Saint-Etienne will be equipped with an instrument constructed by the GAP (Groupement pour l'Automatisation de la Production). The first prototype made by GAP has been operating in Cappelle-La-Grande, since the beginning of 1989. In Angoulême, the instrument is made by Damon, an other french constructor. On the other hand, the "Université de Haute-Alsace" in collaboration with the firm "Astromicron" developed a special effect projector called "Planetshow".

The "Association des Planetariums de Langue Française" lists also almost 30 small itinerant Planetariums, essentially of Goto and Starlab type, but also "artisanal" constructions, such as those conceived by Mr Matthieu and by Mr Colas in the North, and by Mr Dumas working in the South. Mr Dumas's activity takes place in the framework of the Popular University of Orange ; in 1988, 14 000 persons have attended to his sessions. He travels from town to village, from schools to cultural centers, and so on. He is also presenting a large range of small instruments and didactic models, and presents audio-visual realisations under the dome of his self-made Planetarium.

In one year, about 120 000 visitors could enjoy the performances of small Planetariums. It is very interesting to notice that in this case 60 % of the operators are benevolent teachers.

1. Annual meetings:
Since 1984, the "Association des Planetariums de Langue Française" has been organizing annual meetings. The first meeting with constitution of a working group took place in Strasbourg at the occasion of the First Colloquium of the European Planetariums. The following meetings took place in Paris (1986), in Nantes (1987), in Paris (1988) at la Cité des Sciences et de l'Industrie de La Villette at the occasion of the Second Colloquium of the European Planetariums, in Meribel (1989), in Nice (1990). The coming meeting is planned to happen in Pleumeur-Bodou (Bretagne).

2. Achievement and diffusion of documents:
The "Association des Planetariums de Langue Française" collects and diffuses astronomical materials such as audiovisual arrangements (slides, video), postcards, educational books. It also achieves Planetarium shows (see Table 2) written with the collaboration of astronomers.

3. Educational actions:
An "Ecole d'Eté d'Astronomie" is organized every two years. It is aimed to improve the knowledge in Astronomy of teachers.

Diplomas for Planetarium Operators (First degree and Master's degree) have been created in order to valorize and homogenize the "Operator-job" (see Figure 2).

### Table 1: THE PLANETARIUMS IN FRANCE 1990

<table>
<thead>
<tr>
<th>CITY</th>
<th>MODEL</th>
<th>OPENING DATE</th>
<th>DOME</th>
<th>CAPACITY</th>
<th>PROJECTORS</th>
<th>SLIDES</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>Zeiss Jena</td>
<td>1952</td>
<td>15 m</td>
<td>201</td>
<td>12</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Palais de la Découverte</td>
<td>Goto</td>
<td>1985</td>
<td>8 m</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Le Bourget</td>
<td>Spitz Voyager</td>
<td>1986</td>
<td>21,5 m</td>
<td>200</td>
<td>125</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Cité des Sciences</td>
<td>GAP SN88</td>
<td>1989</td>
<td>10 m</td>
<td>70</td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Nantes</td>
<td>Zeiss ZKP2</td>
<td>1981</td>
<td>8 m</td>
<td>62</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Nimes</td>
<td>Zeiss ZKP2</td>
<td>1982</td>
<td>8 m</td>
<td>65</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pleumeur-Bodou</td>
<td>Zeiss Astron.</td>
<td>1988</td>
<td>20 m</td>
<td>270</td>
<td>16</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Reims</td>
<td>Zeiss ZKP2</td>
<td>1980</td>
<td>6 m</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strasbourg</td>
<td>Spitz 312</td>
<td>1982</td>
<td>8 m</td>
<td>65</td>
<td>10</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Toulouse</td>
<td>Zeiss ZKP1</td>
<td>1975</td>
<td>6 m</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In construction and in project:*
- Angoulême (1990) : 8 m - Bordeaux
- Poitiers (1991) : 15 m - Lyon
- Saint-Etienne (1991) : 10 m - Vichy
# PLANETARIUM SHOWS

<table>
<thead>
<tr>
<th>TITLE</th>
<th>ORIGINE</th>
<th>DURATION (min)</th>
<th>SLIDES</th>
<th>DATE OF ISSUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Voyage à travers le Temps (Travel through the time)</td>
<td>Strasbourg</td>
<td>45</td>
<td>140</td>
<td>1989</td>
</tr>
<tr>
<td>2. Soleil, notre Etoile (Sun, our star)</td>
<td>Strasbourg</td>
<td>45</td>
<td>120</td>
<td>1990</td>
</tr>
<tr>
<td>3. Vie et Mort d'une Etoile (Birth and death of a star)</td>
<td>Strasbourg</td>
<td>23</td>
<td>160</td>
<td>1990</td>
</tr>
<tr>
<td>4. Regard vers le Cosmos (Glance to the Cosmos)</td>
<td>Strasbourg</td>
<td>37</td>
<td>114</td>
<td>1990</td>
</tr>
<tr>
<td>5. L'Univers cet Inconnu (An Unknown : the Universe)</td>
<td>Strasbourg</td>
<td>50</td>
<td>140</td>
<td>1990</td>
</tr>
<tr>
<td>6. En phase avec la Lune (Phasing with the Moon)</td>
<td>Strasbourg</td>
<td>45</td>
<td>in progress</td>
<td>1990</td>
</tr>
</tbody>
</table>

In preparation:
- Le Cosmos et la Terre (Cosmos and Earth)
- La ronde des planetes (The planets' dance)
- Sommes-nous seuls dans l'Univers ? (Are we alone ?)
- L'Etoile de Bethléem (Christmas Star)

All our shows include:
1. a soundtrack with text and original music (tape adapted to the equipment)
2. a box with slides (in colour, with educative schemes, photos of planets (NASA), clusters, nebulae and galaxies
3. a booklet with the show text, the timing and several indications about the synchronization of the movements of the Planetarium projector, the light variations, the change of slides...
4. a proposition of one (or more) specific "special effect" projector(s): Astromicron or Conic.

* Achieved and diffused thanks to the help of the French Ministry of Research and Technology (Delegation to the Scientific and Technical Information)
First of all, let me express my gratitude to be invited to present this paper on the projects and activities developed in the planetaria of Spain and Portugal.

To do it, I have used as a reference the last issue of the IPS directory, and I have contacted with most of the planetaria reported.

According to the Directory, there are 2 planetaria in Portugal and 15 in Spain. As far as I know, there are operative 16 in Spain and 1 in Portugal. This map shows it location.

However, if we consider the activity and installations of those planetaria, one can outline the following groups.

The first one could be formed by a network of planetaria installed some 20 or 25 years ago. As you can see in this drawing, they are placed along the Spanish coast in different navigation schools.

The second group is formed by the public planetaria. There are five in this group: four in Spain and one in Portugal. The first to be installed was the Planetario Calouste Gulbenkian in Lisbon, Portugal, in 1964, who is part of the Morinha Museum. The Spanish planetaria have been installed after 1980. Those of Casa de las Ciencias in Coruña and Museu de la Ciencia in Barcelona, are part of a Museum, while Planetario de Madrid and Planetarium Barcelona, are "just" a planetarium.

Finally another group is formed with smaller planetaria, like the one installed in a elementary school in Barcelona, and three portable ones operated by the Science Museum also in Barcelona.

As immediate projects, there are three public planetaria in Spain, located in Castellón, funded by the City Hall, Pamplona, under the auspices of the local government, Sevilla, to be build in occasion of Expo 92, and one in Porto, Portugal, linked to the University.

Now, some remarks on the activities.

In the first group, the main activity is the teaching of astronomy for navigation to their own students, but most of them are also visited by groups of students coming from schools and high schools of their area, and normally they limit the visits to ages between 13 and 18. In most cases, the equipment is limited to the main projector and the programs are based in the recognition of constellations and the study of the daily motion, and are presented live. The time devoted to students coming from other institutions, is very different from one to the other.

As a special remark, the planetarium in Gijón (a 8 m dome) has established an agreement with the University and the City Hall, to open the planetarium to the public every afternoon. Their estimation of attendance is of 30000 visitors per year.

With regard to the public planetaria, all them present both public and school shows in very different ways. In the Lisbon Planetarium, all shows are presented live, while others do it fully automated. We, at the Planetarium Barcelona present public shows taped and automated, and school shows, partially live and partially automated.

In Spain, the two public planetaria in Barcelona, are owned by privated foundations, and Coruña and Madrid are of the City Hall.

Finally, let me show you some figures on those public planetaria.

As a conclusion, we could say that the present situation is not so bad. However, several things can be done. In compiling the information to write this paper, I have detected an improtant devoid of contact between the planetaria, something that I personally will try to solve in a very near future.

Thank you very much.
PUBLIC PLANETARIUMS IN SPAIN AND PORTUGAL

LOCATION

- VIGO
- CANARY ISLANDS
- St. Cruz de Tenerife
- Arrecife
- SANTANDER
- BILBAO
- PASAJES
- GIJON
- MARIN
- BARCELONA
- MADRID
- LISBOA
- ALICANTE
- CADIZ
- ARRECIFE
- STA. CRUZ DE TENERIFE

PUBLIC PLANETARIUMS IN SPAIN AND PORTUGAL

SIZE AND CAPACITY

<table>
<thead>
<tr>
<th>Planetarium</th>
<th>Dome Size</th>
<th>Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museu Ciencia (B)</td>
<td>9</td>
<td>74</td>
</tr>
<tr>
<td>Planetarium Barcelona (B)</td>
<td>12.5</td>
<td>117</td>
</tr>
<tr>
<td>Casa de las Ciencias (C)</td>
<td>10</td>
<td>84</td>
</tr>
<tr>
<td>Planetario de Madrid (M)</td>
<td>17.5°</td>
<td>250</td>
</tr>
<tr>
<td>P. Calouste Gulbenkian (L)</td>
<td>23</td>
<td>330</td>
</tr>
</tbody>
</table>

* 10° tilted dome

PUBLIC PLANETARIUMS IN SPAIN AND PORTUGAL

ATTENDANCE

<table>
<thead>
<tr>
<th>City</th>
<th>Planetarium</th>
<th>No Visitors</th>
<th>Distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARCELONA</td>
<td>Museu Ciencia</td>
<td>150,000</td>
<td>45</td>
</tr>
<tr>
<td>BARCELONA</td>
<td>Planetarium Barcelona</td>
<td>67,000</td>
<td>80</td>
</tr>
<tr>
<td>CORUNA</td>
<td>Casa de las Ciencias</td>
<td>86,000</td>
<td>57</td>
</tr>
<tr>
<td>MADRID</td>
<td>Planetario de Madrid</td>
<td>280,000</td>
<td>30</td>
</tr>
<tr>
<td>LISBOA</td>
<td>P. Calouste Gulbenkian</td>
<td>124,000</td>
<td>80</td>
</tr>
</tbody>
</table>

* This Planetarium is working some 10 hours daily.
** Free for 75 percent of visitors.

IMMEDIATE PROJECTS

- Porto
- Pamplona
- Sevilla
- Castellon
- (12.5 m/1991)
- (20 m/1992)
ACTIVITIES OF ITALIAN PLANETARIA

Loris Ramponi

ABSTRACT
Italian planetaria present a wide range of features as far as equipment, instruments, activities and architecture are concerned. The most frequent models are the small ones operating mainly for schools. Actually the didactic use of planetaria is prevailing on the spectacular side. The two biggest planetaria are in Milan and Modena, but there are quite a few smaller, selfmade models and some more are at the blueprint stage.

INTRODUCTION
Since 1986 Italian Planetaria Friends Association has been promoting the diffusion of planetaria in Italy and has been organizing yearly meetings (Ravenna 1986, Brescia 1987, Modena 1988, Rovigo 1989 and next October in Milan). The association, which is situated at the Science Museums of Brescia, is coordinated at national level by professor Mario Cavedon (Milan Planetarium) and by professor Franco Gabici (Ravenna Planetarium), while Brescia amateur astronomers deal with its organisation. Thanks to the activities of A.A.P. the lack of information existing in Italy in the fields of planetaria is now disappearing: before 1986, in fact, there was no complete list available of planetaria working in Italy.

The situation of Italian planetaria is quite different from the international one. Actually in our country the most frequently used planetaria are the small models, operating mainly for schools. Modern science centers, with adjoining planetaria, are not yet widespread in Italy, where natural science and science history museums are prevailing. Only a few cities have big planetaria (generally quite new) which propose lectures from both schools and the general public. As far as seats, architecture, management, equipment and activities are concerned there are wide differences among planetaria. The buildings specifically for this purpose are in Milan, Modena and Ravenna. The others are mainly located in schools or buildings provided by municipalities. The management includes mainly schools then amateur astronomers and public and private institution. The projectors in use are from Aus Jena, Goto, Starlab and Zeiss and also some Italian firms: Galileo (out of production), Gambato and Zen.

DESCRIPTION OF MAIN PLANETARIA
The two biggest planetaria, both for buildings and instruments, are in Rome and Milan: the former has been closed for years and the instrument is quite out of date and situated in an old building, the ancient Terme of Diocleziano, which is now used for other purposes. The latter is the most active planetarium in Italy: it is situated in a public park, next to the Natural History Museum, which manages it, and they both depend on the municipality. The staff includes employees (a technician and some office workers) on one side and lecturers and a scientific chairman who have a professional contract on the other. Milan Planetarium has a 20 meter diameter dome (Zeiss IV projector model) and can seat 320 people: it records a public attendance of over a hundred thousand people yearly. Besides school lesson the planetarium gives 4 public lectures every week-end, based on sky observations, on Saturday and Sunday afternoons, aimed to the general public and therefore not focused on technical subjects. The evening lectures are much more specific and they are grouped in mini-courses centered on single themes. The planetarium is closed for two months during the summer.

Mr. Gambato and Mr. Zen are two different craftsmen who produce optical components for telescopes and recently also a medium sized planetarium of very good optical quality and quite cheap. In the next years their production might promote the diffusion of planetaria in Italy also in small towns thanks to the low cost of projectors. The main feature of this instruments is the presence of one lens for each single hole in the star sphere. The resulting image is therefore pointlike and the projected sky is very realistic. Also domes have very good prices and are offered along with a kit composed of single parts in plastic which the purchaser has to fix on a simple metallic frame. There are also two selfbuilt planetaria, one in Venezia Lido and the other one in the province of Treviso (Crespano del Grappa): the latter is under construction in the astronomical open air park which exhibits reproductions of old astronomical instruments. Two itinerant Starlab Planetaria are used in the cities of Turin, where there is also a project for a medium planetarium, and Brescia. The equipment in use in Italian planetaria includes only slide and video projectors and a few supplementary projectors, but no panoramic horizon (there are only fixed city skylines), no multislide, hemispheric films, hemispheric slide or laserium projector. According to some planetarians this lack of instruments prevents a more spectacular effect during public lectures, while others don't feel this problem both for their limited budget and the small domes in their planetaria. Actually the use of instruments in Italian planetaria is strictly didactic (aiming to the teaching of astronomy both to students and the general public, and not to performances or shows) and the basic equipment satisfies this need.

Modena ten meter Spitz dome (ZKP 2 Aus Jena projector model), in which can seat 80 people, is the second largest planetarium, but the first one if we consider also the
rooms next to the planetarium hall: a conference lounge, in which can seat 150 people, a room for school lessons, a darkroom, a library, workshops, the offices and a sunroof for telescope observation. A selfbuilt reproduction of Foucault pendulum is on permanent exhibition too. There is also a room for the small Goto EX-3 planetarium, which has been used for ten years and is now utilized for practical exercises with teachers. The planetarium is situated in the precincts of a high school. The caretakers and the office workers are the same for both, while the lecturers and the teachers who come from this and others schools who have a long experience in the use of Goto. The planetarium has been operating since last spring and gives morning lessons for schools every day and two evening lessons a week, July and August excluded, for the general public.

Also the planetarium in Ravenna, operating since 1985, has available rooms next to the projector lounge (8 meter dome, 54 seats, ZKP 2 model): besides the offices and the ticket office there is a conference hall with a video projector and a large sunroof for astronomical observations organized by local amateur astronomers. The planetarium is run by a director, a technician and a secretary (employed by the local administration) and also, as far as evening conferences are concerned, by a local amateur astronomers group. A collaborator on a professional contract works with the director on the morning lessons for schools. In the planetarium of Ravenna, which is a well-known tourist site, classic musical concerts in combination with projections are also organized. The planetarium is inside a public park where a permanent open air exhibition of old astronomical instruments has been planned by the director. Ravenna planetarium also edits an important almanac.

OTHERS PLANETARIA

Milan, Modena and Ravenna planetaria are managed by local municipalities, while the others are mainly managed by schools, or local amateur astronomers. The 8 meter dome selfbuilt planetarium in Venezia Lido is situated together with the seat of the local group of amateur astronomers in a convent: it has an automatic projector of high quality resulting from the hard work of three Venetian amateur astronomers. In the 4 meter dome planetarium in Padova a full time amateur astronomer works intensively for schools. The astronomical observatory is situated in the same building. The six meter dome planetarium in Treviso is managed by local amateur astronomers but directed by an astronomer. Amateur astronomers also manage the small planetarium in Marghera which is situated in a private religious school. Mr. Gambato is the builder of this planetarium: another of his models is operating in a convent in the province of Terni (Amelia) and another one is at the blueprint stage in Ferrara. Mr. Zen, the other craftsman mentioned at the beginning of this communication, has built the model operating in Cagliari, in the Nautical Institute, in Rovigo (a public observatory is being planned here, both promoted by the local amateur astronomers) and in Brescia (not yet working).

The first Italian public observatory has been operating in this city since 1953. It is managed by the local group of amateur astronomers on behalf of the municipality. This group also runs a small Goto, an itinerant Starlab planetarium and an Earth-Sun well equipped didactic observatory at the local science Museum. The same group is also planning a public observatory with conference hall, workshops and a 8 meter dome planetarium in the near small town of Lumezzane (Brescia), in collabororition with private sponsors and the local municipality.

Public institutions manage the planetarium in Florence (5 meter dome) at the Science History Museum, Livorno and Pordenone Natural History Museum, Napoli (Observatory of Capodimonte), Rivanazzano (Pavia) public library: four of them are Goto EX-3 models. The total number of Italian planetaria is 55, including the models already bought but not operating yet. See for other informations the annual Directory of I.P.S.

REFERENCES

AA.VV., Acts of the 1st national meeting of Italian planetaria, Ravenna 1986 (in Italian).
AA. VV., Acts of the 2nd national meeting of Italian planetaria, Brescia 1987 (in Italian).
AA. VV., List of Italian planetaria, Specola Ciclnea Almanac, 1990, pp. 63-64 (in Italian).
Dear Colleagues,

At the outset I would like to express my joy, sharing it with you all, that the planetarium-movement is very much afoot today, having started in the present form more or less, about three quarters of a century back. It seems to be growing from strength to strength. We get an ever-encouraging picture of the situation as we compare the IPS Directories of successive years - thanks to Mark Peterson for keeping us regularly updated that way.

Now for something specific from my part of the globe. As you know I come from India, in Southern Asia. In fact, ours is the largest country there - areawise and populationwise. You will be glad to know that, in Southern Asia in general and in India in particular, the climate is quite conducive to the growth of planetaria - and the crop therefore has been quite satisfying during the past decades. I will be more specific. We started our Planetarium in Calcutta in 1962. It is called the Birla Planetarium, Calcutta. At that time it was the only planetarium not only in India but in the entire South Asia. Two more were then under construction - one in Hanoi, Vietnam, and the other in Bangkok, Thailand. As against these figures, consider that today planetaria that are already functioning, or going to start functioning soon, number 41, out of which nearly 30 are in India. Impressive figures - aren't they? Keep in mind in this connection, a planetarium is quite a costly proposition, and no one of the countries in Southern Asia may be called a developed country, still some of them are only developing, some of them quite underdeveloped yet.

Another thing, that is very heartening, is that the planetaria in our parts are well-patronized by visitors. Birla Planetarium, Calcutta, for example, is attended by more than 2000 visitors daily, on an average, and we are, by popular demand, open on all seven days of the week. Incidentally, ours is a large one - dome-diameter measuring 25 m. Another planetarium in India - the one in Bombay, started in 1977 - has the same size. The others are small. But big or small, they may all be said to be quite popular.

This question of high popularity or mass-appeal is interesting - it is, apparently, intriguing. People love to visit planetaria again and again and enjoy different astronomical shows in India, though a sizeable portion of the population is still illiterate. The significance is noteworthy. Literacy and curiosity do not necessarily go hand in hand together. If you can make it interesting by the spoken word, that is good enough for many people.

Before I finish, may I utter a word of caution for all planetarians to ponder over? I have noticed a tendency, in some planetarians, to very much dilute the astronomical content in the shows they produce and to mix them heavily with other things. That is not conducive to the healthy growth of a planetarium. If you hold a show under the planetarium dome - about something that has practically nothing to do with astronomy - say about the alternating current, Nicola Tesla's thoughts and experiments about it, well, you may be able to make it very entertaining or even engrossing, but that would not redound to your credit as a planetarian. It would be self-defeating, self-destructive in the long run. I believe, unless the planetarium can retain its identity, as distinct from that of a cinema or a theatre or a magic show, it will dig its own grave - slowly maybe, but surely enough.
PLANETARIUMS IN THE FAR EAST AND JAPAN

Shoichi Ito

Recently I have had a personal communication with a couple of planetarians at the Beijin Planetarium in China. In the Beijin Planetarium alone they have a staff of about 800 and there are more than one million visitors every year. It publishes for Chinese planetarians a quarterly journal named Planetarium Information. In China there are some 30 planetariums now and it seems they will soon amount to more than 50. The first planetarium conference of all China was held in 1988 at Beijin and they seem to have diligent and powerful activities.

In Taiwan we find 7 planetariums in the IPS directory and one more Space Theater will open in a few years.

In Korea there are about 10 planetariums, but I have no information about their activities.

In the response to the request by the Government of Malaysia, the Government of Japan has decided to provide the planetarium equipment under the Japanese Grant Aid for the National Space Science Education Center in Kuala Lumpur, Malaysia, which will open next summer. We hope it will contribute to astronomy and space science education for the Malaysian people.

In Japan there are about 270 planetariums now, most of them being public institutions, and around 150 of them are open to the general public. But as I mentioned at the IPS Conference in Richmond in 1988, almost all of them have a small staff which are for the most part non-experts and actually they are at short intervals transferred as local government officials to other posts that have nothing to do with planetariums and the newcomers at the planetariums are novices. So, a large part of planetarians don’t produce their own programs nor can they develop their own projection systems, particularly in the latest, big planetariums which have sophisticated projection systems. Consequently the activities of Japanese planetarians are not on a high level expect for those of a small number of them, the professionals.

But there have been recent efforts to activate the planetarium organization. Only last month, Zenkoku Planetarium Renraku Kyougikai, the conference of the Japan Planetarium Association, was held at Nagoya Science Museum and there were many significant discussions on the activation of our planetarium organization. We talked about its definite, practical plans, such as the publication of a journal, editing a planetarium handbook and starting a planetarium techniques seminar for beginners.

Nowadays the planetariums of the space theaters type are increasing in Japan. 15 planetariums out of the 23 that are to be opened in three years, 1989-1991, are of this this space theater type. It is quite unbelievable. Personally I love space theaters, but I don’t see why we have to have space theaters everywhere in Japan! I’m quite doubtful whether or not this new type of planetarium will always contribute much to a better teaching of astronomy and space science, for they need too much money and manpower compared to traditional ones.
Fellow Colleagues,

The United States contains the largest concentration of planetariums in the world. The United States contingency within the International Planetarium Society consists of seven geographical regions. These include the Middle Atlantic Planetarium Society (MAPS), Great Lakes Planetarium Association (GLPA), Southeast Planetarium Association (SEPA), Great Plains Planetarium Association (GPPA), Southwest Planetarium Association (SWAP), Rocky Mountain Planetarium Association (RMPA), and Pacific Planetarium Association (PPA).

Some of these regions have been in existence for several years. The Middle Atlantic Planetarium Society recently celebrated its 25th Anniversary Conference May 2-5 at the Benedum Natural Science Theater in Wheeling, West Virginia. The Great Lakes Planetarium Association will hold its 25th Anniversary Conference this fall at the Indianapolis Children's Museum Planetarium in Indianapolis, Indiana. All seven of the United States regional groups are extremely active in planetarium affairs, both nationally and internationally.

Dome diameters range from 2.5 meters to 24 meters and dome configurations range from horizontal to tilts up to 40 degrees. Seating capacities are anywhere from 10 to 750 and are arranged in a wide variety of configurations (concentric, chevron and unidirectional).

Several portable (inflatable) planetariums exist, most of which are used for educational outreach programs, however a few are used in private enterprise ventures.

Equipment inventories contain almost every conceivable piece of hardware manufactured. New technology is constantly coming on line including computer automation, video, satellite downlink capabilities, LASERS, films (Cinema-360, 8-70mm, Omnimax and Imax formats), liquid crystal projectors and digital sound.

Planetarium attendance in United States ranges from several hundred to several hundreds of thousands per year.

Average attendance nationwide is on the increase, partly due to a renewed awareness in science education and the quest for knowledge acquisition.

Planetarium programming consists of live productions to fully automated presentations. Some United States institutions offer professional workshops that share expertise in current hardware and software applications as well as production techniques. These include the Strasenubg Planetarium in Rochester, New York; the Bishop Planetarium in Bradenton, Florida and the factory planetarium at the Spitz plant in Chad Ford, Pennsylvania. All of these professional workshops are HIGHLY RECOMMENDED!

As a whole, the state of the planetarium community in the United States is healthy. However, poor economic conditions in some areas are forcing some facilities into temporary or permanent closures. On the brighter side of this, several new facilities are scheduled to open in the near future.

All regions are organized by charter and elect officers and board members to oversee policy and operations. All regions meet at least once a year for conferences at facilities in their respective regions. Each region either elects or appoints a representative to the International Planetarium Society which allows for important cross-communication.

In summary, the United States planetarium community is healthy overall and is growing steadily. Many challenges and opportunities lie ahead and we are looking forward to meeting them with enthusiasm. We are proud to be able to share these achievements with our colleagues in the international community.
MIDDLE ATLANTIC PLANETARIUM SOCIETY

Steven Mitch

The 25th Anniversary Conference of the Middle Atlantic Planetarium Society was held this past Spring at the Benedum Natural Science Theater in Wheeling, West Virginia. The 1991 conference will be held at the Fels Planetarium of the Franklin Institutes in Philadelphia, Pennsylvania May 1-4.

The MAPS membership roster currently contains 147 members.
The current officers are:
- Tom Stec - President
- Steven Mitch - Vice-President
- Sam Storch - Treasurer
- Joyce Towne - Secretary

The current members of the Board of Directors are:
- Fred Stutz
- Lee Ann Hennig
- Jon Bell

The publications chairman is Don Knapp.
The MAPS publication is The Constellation and is sent to the membership on a quarterly basis at the equinoxes and solstices.

New facilities within the MAPS region include:
- Christa McAuliffe Planetarium - Concord, New Hampshire

THE GREAT LAKES PLANETARIUM ASSOCIATION

Jeanne E. Bishop

The Great Lakes Planetarium Association was organized in 1965, holding its first conference at year 0. Thus the group will hold its 26th conference this year, but will celebrate 25 years of existence. GLPA is the oldest organization which is now an affiliate of IPS. We have about 250 members, consisting of people who single-handedly operate small planetariums (the largest number) and people from some middle and large planetariums. Most of the planetariums are associated with schools, although a number of museums are represented, and some of the schools are colleges and universities. A number of our members are from places outside our immediate region.

Last year the conference was at Champaign, Illinois, hosted by David Linton. Featured on the program were Terence Murtagh, Phil Klass, Roy Gallant and Rabbi Brad Bloom, the latter speaking on "the December Dilemma" with respect to Christmas planetarium programs.

This year's conference will be held October 10-13, in Indianapolis, hosted by Sharon Parker. Ben Bova and "the Amazing Randi" are on the program. Our 1991 conference will be held in Youngstown, Ohio, hosted by Warren Young and Rick Pirko.

GLPA has a large number of publications. We publish our conference proceedings. The 1988 and 1989 proceedings are both in hands of members, the former being 125 pages long and the latter 110 pages but with smaller type so that there are twice the number of words. Both were prepared by Dale Smith. These can be obtained for $15 each by contacting Gary Sampson.

A recent publication, the GLPA Source Book, which lists sources of planetarium hardware, projection equipment, films and videos, computer software, teaching materials, telescopes, and reference...
books, can also be obtained from Gary Sampson. His address is Wauwatosa, West High School, 11400 West Center Street, Wauwatosa, Wisconsin 53222, USA. The Source Book was prepared by Greg Williams, and the cost is 8 to non GLPA members.

GLPA operates both a slide bank and a script bank and has published several "Tips" booklets still available for purchase by anyone. Slide and script privileges are only for members. If you would like to join GLPA, regardless of where your planetarium is located, annual dues are 20.

Bart Benjamin of Triton College is GLPA Newsletter Editor. For people who now are sending me affiliate newsletters, please note this change of editors.

The current President of GLPA is Dan Goins and our President elect is Dale Smith. David Parker has been our excellent Secretary-Treasurer for a number of years.

SOUTHWESTERN ASSOCIATION OF PLANETARIUMS

Donna C. Pierce

SWAP officers elected at the Annual Conference in Tyler for two year terms are: President - Linda Irby (Science Place 2 and Richland College Cosmic Theatre); Vice-President - Jim Rusk (Mesquite Schools Planetarium); Secretary/Treasurer - Donna Favour (Richardson I.S.D. Planetarium); Newsletter Editor - Charles Hemann (UALR Planetarium); IPS Rep - Donna Pierce - (Highland Park Planetarium); Robert Wollman (Richard King High School Planetarium) and Wendi Cowger (Kirkpatrick Planetarium) - Board of Directors. The prestigious H. Rich Caluird Award for outstanding professionalism and service to the Planetarium Field was awarded to retiring Professor Paul R. Engle (UALR Planetarium)! The planetarium suffering the most distressing or major disaster during the year was given to Keith Goering for losing his planetarium entirely (Chanute High School literally demolished the room)!

Dates for the next Conference were set for September 27, 28 and 29, 1991 at Don Harrington Discovery Center in Amarillo after host Steven Zavalney polled the members present on the feasibility of a conference in the fall. RMPA will hopefully join SWAP members for this Conference since the site is so centrally located. Of course, all affiliates are always invited! You won't want to miss where the wind blows, the wheat grows and oil use to flow - and one can see forever, and ever, and ever, and ever! So mark your calendars in advance.

For a 1992 Conference site San Antonio College Planetarium and Clyde W. Tombaugh Space Theater in Alamogordo are "thinking" about it - in the meantime Richland College Cosmic Theatre in Dallas has thrown their hat in the ring! What a choice! SWAP feels things really are looking up (pun intended) as over 50 members attended the Conference last spring!
International Planetarium Society Committee Reports

THE PLANETARIAN

John Mosley

The Planetarian is in good health. In the 3½ years I have been Editor, it has been on time, the budget has not increased, and the length has approximately tripled. This is possible because of desktop publishing; most articles are submitted electronically, and I prepare the issues on my home computer.

I would like to see increased participation, especially by non-US members. I ask conference delegates to please consider how they might participate, and I offer several suggestions.

Members should think of The Planetarian when looking for a place to publish. Good articles are always needed. Would conference hosts please recommend the best papers for publication. And would members bring to my attention good articles that appear in low-circulation journals where it might be appropriate to ask permission to reprint in The Planetarian.

Members can participate in existing features. The Forum needs respondents—please volunteer to Lonny Baker. Regional Roundup also merits better international coverage, and those regions that have made the fewest contributions are the British Association of Planetarians, the European Association of Planetarians, and the Planetarium Association of Canada.

We need editors of new columns. There could be several new monthly features, among them could be columns devoted to: (a) special effects, (b) All-Sky projection systems, (c) astronomy exhibits, (d) portable planetariums, (e) art and literature under the dome, and (f) others that members will think of. Volunteers are needed.

Would all members think to notify me of deaths of prominent planetarians so that proper obituaries can be printed. We should remember and honor our fellows who pass on, but I must rely on people who learn of deaths to prepare obituaries.

There are few commercial advertisers from outside the United States. Are there no European products that would sell worldwide?

Please volunteer, and make yourself known to me.
IPS PORTABLE PLANETARIUM COMMITTEE
Susan Reynolds

There is in existence, as of the summer of 1989, a formal International Planetarium Society Committee for portable users. The intent of this report is threefold:

1. To inform you of the chain of events that occurred which prompted IPS to designate a special committee for portables.
2. To describe current communication between users and the resulting accumulation of data and programs.
3. To explain why your input is needed.

The first mention of the possibility for such a committee occurred at the 1988 IPS conference in Richmond, Virginia. Some members felt that portable users were being treated as second class citizens at conferences and in publications. Several attendees signed up to work on this informal committee and a coordinator was chosen. Initial communication among members proved to be minimally fruitful as were all attempts to obtain a comprehensive list of portable users. After many discussions with IPS members, other portable users, and vendors, the conclusion was drawn that a major contribution to IPS and other portable users would be to develop four specific reference files. The first file would contain descriptions of various portables on the market. The second file would hold a list of all known portables around the world. The purpose of the third file would be to include a collection of programs being used at these locations or catalogs of affordable technology for use in portables would make up the fourth file.

A plan and a plea for support was sent to the 1989 IPS council meeting. The council was most supportive and created a formal committee with these directives: "This committee shall exist to help those who are interested in the use of portable planetariums. The group is directed to decide on its name (tentatively called the Portable Planetarium Committee) and also to submit a budget to the officers."

A first mass mailing of approximately 300 letters elicited responses from a grand total of twelve people. A notice placed in "The Planetarian", an IPS publication, proved to be equally ineffectual. As time passes, however, this committee continues to become more worthwhile as more people become aware of our existence. Continued efforts have been made to communicate with all planetarium users and distributors through phone calls, letters and papers delivered at conferences. These efforts proved to be very productive. Individuals and organizations began contacting me with a wide variety of requests. Some of their concerns include where to get replacement parts for the Viewiex Apollo system, how the various portable systems compare, and what system would be best for their situation. Many members are interested in developing a list of people who can provide quality inservice training for new users and demonstrations at local science and astronomy conferences. Requests have been made for copies of existing lesson plans and curriculum outlines as well as for advice about how to develop a curriculum which reflects state and school system mandates.

Enough information has been received to allow for the establishment of files containing a list of approximately 300 portable users, a substantial collection of lessons, a small set of brochures from vendors, and a few designs for easy to make special effect devices. Many individuals have offered support and help with any projects that we undertake in the future. Informative letters have been received from various states and countries in which they share what they are doing with their programs. Notices have been received from IPS affiliate groups stating that they are also establishing portable user's groups.
It has been communicated to this committee that users want vendors to be more responsive to their needs and receptive to creative suggestions. Ideas for curriculum development and speedy dissemination of these materials is crucial at this time of renewed interest in science and space. Portable users are seeking programs which reflect current educational theories including the use of participatory lessons and the application of inquiry and language arts skills. Specific suggestions have been made to vendors by several of our colleagues. Hopefully these companies will heed our requests and come up with some incentives for the development and sharing of designs for imaginative equipment and programs.

As members of the planetarium community you can help by providing input. IPS has directed us to consider other titles for this committee. We need to know if you feel that the present name is too exclusive and should in some way include all small planetariums that primarily use participatory techniques. Gary Lazich, of the Buehler Planetarium in Florida, suggests that we call our committee the International Planetarium Society's Portable or Inflatable Planetarium Systems (IPS' PIPS). This title could encompass both small and portable units. We need your opinion and we’d like to know how you are currently involved with using a portable. Please contact me with any other data for our files (especially locations of portable users), requests for information, or suggestions at the above address. For more immediate concerns you can contact me by phone at (315) 433-2671 or (315) 656-2514.

The communications that have been received are a very positive indication that this committee can be beneficial for everyone. As we continue to work together a more complete and useful set of reference files will be developed. It is encouraging to see a trend at conferences where more papers and workshops dealing with interactive lessons in portables are being presented. IPS membership and astronomy education will benefit from keeping the "little guys" in the fold and rubbing elbows with the "big guys". We may be small but we can be powerful when used effectively.

THE CONSUMER AFFAIRS/ASTROLOGY COMMITTEE
Jeanne E. Bishop

1. Following Council acceptance of the statement on Star Names at the 1983 IPS conference in Richmond, it was distributed at the conference and subsequently published in The Planetarian.

During the last year, Sky and Telescope editors asked me to share my views on the International Star Registry's practices. The resulting "Focal Point" article mentioning the IPS disposition appeared in the February, 1990, Sky and Telescope issue.

2. Over the last two years I have dug deeply into the nature of astrology, its popular and serious acceptance, and the English con-astrology literature. The result is an article, "A Brief Review of the Astrology Problem with Emphasis on the North American Situation, with Recommendations." I invite those with considered views on the subject to see me for a pre-publication copy of the article and to prepare a two- or three-paragraph "view" which could be published in a section following the article in The Planetarian.

Several points which may be of interest to all, not generally understood by scientists and planetarium professionals, which are included in my review are:

1. "Serious" astrology, which takes many other factors (typically 40) into consideration with the sun sign, is the predominant type of astrology of practicing astrologers. Popular or sun-sign astrology, which usually considers only the birth sign (of traditional or precessionally-corrected) is the type that gets greatest exposure in newspapers and is the type most scientists think constitutes the discipline.

2. "Serious" astrologers dismiss as a joke most arguments that are directed toward popular astrology.

3. Probably half of the serious astrologers believe what they are doing is valid and are not purposely deceiving people to make money.

4. People with a need to see the world as manageable, ordered, and predictable are the group that is prone to acceptance of astrology. Teenagers and women have been found to have large numbers within this group.
5. Con-astrology literature attacks astrology on four levels: physical/logical, philosophical/historical/logical, statistical evidence, and psychological. The first three of these are used most often in debating astrology. However, I conclude that the psychological is the most important. Studies have revealed how people become "hooked" on astrology and why they maintain a belief. Astrologers themselves are victims of psychological procedures.

I have prepared a list of recommendations for the planetarium community, including acceptance of an obligation to oppose astrology and present science as a life-relevant system that can provide an ordered view of the universe.

IPS SCRIPT BANK

Donna C. Pierce

PURPOSE: The IPS Script Bank serves as a repository for show scripts which are available to all members. Scripts on file should be considered only as resource material for show producers not wishing to "reinvent the wheel" when coming up with ideas for show topics. In the committee's opinion, the Script Bank is not being created to interfere with the efforts of independent program producers to produce and sell complete or partial show packages to the members of the society. It is the committee's opinion that all producers who are members of IPS should be encouraged to avail themselves of this service.

OPERATIONAL GUIDELINES:
1) The "seeds" of the Script Bank will be the scripts submitted for judging during the Eugenides Foundation contests, but voluntary contributions will be essential to the success of this project.
2) Original authors/owners must complete and sign a non-exclusive licensing agreement form when offering materials to the IPS Script Bank. This license only covers production and distribution of the submitted item. All copyrights and other rights will be retained by the author/owner. Should the author wish to grant public production or presentation rights to IPS for IPS members, a check-off option for this purpose is on the agreement form. Otherwise, such agreements must be individually negotiated between a Script Bank user and the contributor of the item in question.
3) The International Planetarium Society, Incorporated, will assume no responsibility or liability in the event of copyright ownership or royalties issues which may later arise concerning an item licensed to it.
4) As an incentive, an IPS member who contributes a script will be entitled to receive one of the scripts already in the Script Bank in exchange for their submission.
5) Normally, copies of a script may be obtained at a cost of ten US cents per page, which covers duplication fees, plus applicable postage charges.
6) The IPS Script Bank will be administered initially by Gary E. Sampson.
7) Submissions should be sent to:
   Gary E. Sampson
   IPS Script Bank
   Wauwatosa West High School
   11400 West Center Street
   Wauwatosa, WI 53222 USA
8) A catalog of available scripts will be periodically published in *The Planetarian*.

9) Scripts should be sent to the IPS Script Bank as hard copy with black printing on white paper.

10) A one page English-language abstract must accompany every submission. Ordering information (if the item is for sale) should be included in the abstract.

11) A separate form and abstract should accompany each item submitted. A set of curriculum guides for one show (for example) would be considered one item.

12) The submitting author/owner may have their item withdrawn from further circulation by the Script Bank at any time by making a written request to the administrator of the IPS Script Bank. The administrator will have 10 business days to cease all further circulation. Original copies will not be returned under any circumstances.

13) Comments regarding the IPS Script Bank and its operation should be directed to the Chair of the IPS Script Bank Committee.

INSTRUCTIONAL MATERIALS LICENSING AGREEMENT attached.

The above information may be found in *The Planetarian*, Vol. 19, No.2, June 1990, pp. 21-29.

The IPS Script Bank Committee recommends Thomas W. Hocking as the Chair of the Committee with Donna C. Pierce and Gary E. Sampson as members. Hocking's *The Scriptorium* will feature update information on the IPS Script Bank in future issues of *The Planetarian*.

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International Planetarium Society, Inc.
Script Bank

Instructional Materials Licensing Agreement

I hereby freely license the submitted item(s) described below to the International Planetarium Society, Inc. (IPS) on a non-exclusive basis, to be used as a resource according to the procedures of IPS for the benefit of fellow planetarians. Apart from this license, I, as author/owner of the submitted work (or the Authoring/Owning Institution which I represent), will continue to retain all of my/its institution's rights with respect to said item(s). Additionally, I agree to hold harmless the IPS, its members or its officers from any future liability disputes which may arise concerning this work. I may have this item withdrawn from further circulation by the IPS Script Bank at any time by making a written request to the administrator of the Script Bank. The administrator of the Script Bank will have 10 business days from the date of receipt of my request to cease further circulation. My original copy will not be returned under any circumstances. My signature on this document certifies that I am empowered to execute this agreement.

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Abstract/Description of Submitted Item (include ordering information if item is for sale)

(continue abstract on additional sheet of paper)

The right to reproduce and present the above named article(s) to the public is granted to IPS for use by IPS members if this item is checked.

Signed: ___________________________ Date: ___________________________

Name (Please Print): ________________________________________________

Institutional Address: ______________________________________________

Telephone: ______________________ FAX: ____________________________
REPORT FROM THE LANGUAGE COMMITTEE

Lars Broman

The IPS Language Committee consists of Lars Broman, chairman, Carolyn C. Petersen and Mark Petersen. The Committee has met once during the year.

During the year 1989/90 the IPS Membership brochure was translated into French (by Marie Christine Migozzi), German (by Dieter Herrmann) and Spanish (by Luis Pujol). It was sent out to planetarians in countries where these languages are spoken. The response was low, but we feel that we should continue during some years in order to get some effect. Other possible future activities include the translation of selected articles from The Planetarian for e.g. publication in regional Planetarium Magazines.

The Committee would like to include members with different language backgrounds; Luis Pujol (Spanish) has already accepted membership.

REPORT ON ESTABLISHING A SLIDE BANK

Rita Fairman

There are many problems associated with the establishment of a slide bank for IPS members and none of them are simple.

Some of the problems are: the need to collect, store, duplicate and distribute the slides to those who want them. It is also necessary to catalogue and give an idea of what these slides are like for the prospective buyers. Restrictions on use of the slides must be established. Should access be limited to IPS members, or a different price structure for non-members, or open for all planetarians. The biggest problem of all is where the slide bank would be located and who would be responsible.

The best solution I have found so far is a proposal by GLPA to operate the slide bank for IPS. GLPA has an established slide bank, a location, and someone who has been (and presumably will continue to be) responsible.

While this means that we will have to start our own collection from scratch, it also means that we are starting out with experience rather than having to buy the equipment and build from there.

At this point, this seems to me to be the best way to handle the problem.
PROPOSAL FOR GLPA TO OPERATE A SLIDE BANK FOR IPS

1) IPS provide liability insurance for all losses or liability.

2) Current GLPA slides do not become part of the IPS bank—new slides must be solicited.

3) The solicitation of these slides is the responsibility of IPS, not GLPA.

4) Slides will be copied on the GLPA slide duplicating equipment.

5) IPS will set the fee structure. GLPA only copies, takes orders and sends out the copies or film as our slide curator desires. The slide curator must be reimbursed for any and all costs.

6) If IPS desires the slides to travel, IPS will purchase portable, shipable storage system(s).

6a) If IPS wants to make contact color prints, IPS will pay a contractor for the service.

6b) If IPS wants duplicate slides to travel, IPS will pay costs (in addition to #6 above) of duplicating but GLPA can copy the slides.

6c) If the slides are to be shipped outside of the country, IPS (not GLPA) must handle any customs regulations and forms.

7) GLPA will catalog the slides as IPS wishes or could use the same system GLPA currently uses if IPS wishes.

8) GLPA members have access to all IPS slides through normal GLPA slide bank using normal procedures.

9) If this agreement is terminated by either party, GLPA has the right to copy the slides and place these copies in its bank for the use of its membership.

10) If membership in IPS is a requirement for use of the IPS slide bank, the IPS membership slide curator should be informed of the names of current IPS membership.

11) If IPS wishes its members to have access to the current GLPA slide bank, GLPA will give IPS members 10% off our regular membership dues ($20.00) for new members during GLPA’s fiscal year (Oct 1 to Sept 30) starting Oct. 1 after this agreement is ratified by both parties. These new members will receive full GLPA benefits.
Abstract The European Southern Observatory (ESO) was created in 1962; it now has eight European member states and runs the world’s largest optical observatory at La Silla, 600 km north of Santiago de Chile. Each year more than 400 astronomers observe with the 15 telescopes installed here. The ESO Headquarters in Garching near Munich have become a European centre for astronomy. In addition to furthering a vast scientific activity, ESO has invested much effort in improving astronomical technology. The newly commissioned 9.5 m New Technology Telescope (NTT) has a computer controlled optical system (active optics) which was developed at ESO and which enables this telescope to obtain sharper images than any other large, ground-based telescope. Recent tests with adaptive optics have allowed the elimination of atmospheric seeing effects in the infrared spectral region. ESO now constructs the 16 m equivalent Very Large Telescope (VLT) which consists of four coupled 8.2 m telescopes and which will become the world’s largest optical telescope in 1998. A brief summary is given of some recent scientific achievements at ESO.

I. Introduction

To accomplish its lofty goals and to better understand the universe and the celestial bodies in it, astronomy traditionally employs some of the most sophisticated instruments and methods conceived by man at any given epoch. Well-known examples are megalithic observatories like Stonehenge, the great sighting instruments of Ulukh Bekh and Tycho Brahe, the giant mirrors of William Herschel and today’s astronomical satellites. Ever since antiquity, the best available technology has played an important role in the progress of astronomy.

As in many branches of physics, the complexity of astronomical projects has grown to the extent that most are now carried out by large groups of scientists and engineers, and frequently within an international framework. Frontline astronomical research has become more and more expensive and there is a clear and natural tendency towards more intensive collaboration between scientists and institutes all over the world.
To further collaboration within the various branches of astronomy and to establish optimal observing facilities for their scientists, eight countries in Western Europe (Belgium, Denmark, Federal Republic of Germany, France, Italy, the Netherlands, Sweden and Switzerland) have jointly created a major, international astronomical organisation, the European Southern Observatory (ESO). It is a sister organisation to the highly successful European Laboratory for Particle Physics (CERN) and within its field, ESO has in a similar way made great contributions to the integration of European science. This has become particularly obvious in the most recent years and the organisation now occupies an important place in world astronomy as well.

ESO has established the world's largest optical, astronomical observatory. It has an extensive and dynamic scientific-technical programme in optical, infrared and submillimetre astronomy. Many frontline projects have been fruitfully completed under its auspices and current research with ESO telescopes and instruments encompasses all types of objects in the observable universe, from the nearest minor planets to the most distant quasars. Moreover, ESO has just put into operation the world's most modern, large optical telescope, the revolutionary 3.5 metre New Technology Telescope (NTT). Anticipating the needs of observational astronomy long into the next century, ESO's flagship project is now the 16 metre Very Large Telescope (VLT), which will become the world's largest optical telescope when it is ready towards the end of the current decade.

II. A Brief History of ESO
As the European organisation for astronomy, ESO is modelled on its elder sister, CERN in Geneva. In 1954, physicists in Europe signed the Convention that would create CERN and thereby allow the construction of powerful particle accelerators which were beyond the financial means of any individual nation. At the same time, astronomers on this continent were very impressed by the achievements of the newly installed 5-metre telescope on Mount Palomar, and it was quite natural that some of them got together to discuss future large-scale projects. With Jan Hendrik Oort and Walter Baade as driving forces, consultations were started in several European countries with old astronomical traditions.

The founding fathers of ESO thought about the dark and clear skies over the large mountain observatories in the United States and also about the virtual monopoly of their American colleagues in front-line research in the northern sky. No wonder that they soon decided to look towards the mountains and deserts under the southern sky.

ESO came into being on October 5, 1962, when an international Convention was signed in Paris by the representatives of Belgium, France, Federal Republic of Germany, the Netherlands and Sweden. Noting the lack of knowledge about the southern sky, the preamble states that the contracting states are "desirous of jointly creating an observatory equipped with powerful instruments in the South-ern hemisphere and accordingly promote and organise co-operation in astronomical research". Denmark became a full member in 1967 and was followed by Italy and Switzerland in 1982, bringing the total to the present eight member countries. Others, e.g. Austria and Portugal are actively considering to join.

The search for the best possible site started already in 1955. Nearly ten years later, in April 1964, ESO people inspected a remote mountain ridge near the southern edge of the Atacama desert, designated Cerro Chincado on official maps and located about 600 km north of Santiago de Chile. This mountain was locally known as Cerro La Silla ("the saddle") because of its form, and from the beginning it seemed an ideal site for an astronomical observatory. The meteorological record was impressive by all standards, and a 625 sq. kilometres plot centered on the mountain was bought. An Agreement was signed with the host country, guaranteeing ESO's international status. The ESO land, which was later extended to more than 800 sq. kilometres, is now the largest diplomatic enclave anywhere in the world.

The ESO La Silla observatory was officially inaugurated in March 1969. Thereafter, hardly any year passed without a new addition to the growing telescope park, culminating with the installation in late 1976 of the largest ESO instrument foreseen in the Convention, a classically mounted 3.6 m telescope with prime, Cassegrain and Coude foci.

A 1.4 m Coude Auxiliary Telescope (CAT) was installed next to the 3.6 m telescope in 1980, and in 1984 ESO received a 2.2 m telescope from the Max Planck Society on long-term loan. It was followed by the 15 m Swedish/ESO Submillimetre Telescope (SEST) in 1987 and the 3.5 metre New Technology Telescope in 1989, bringing the present total to fifteen operating telescopes at La Silla.

III. Furthering European Astronomy
Parallel to the developments at La Silla, ESO has spared no efforts to encourage and intensify interactions among astronomers from all over Europe (and abroad), despite their different languages and cultural backgrounds. This works in many different ways, for instance by bringing many scientists together during observing trips to the La Silla observatory. Such encounters have frequently developed into joint research projects.

In 1989, ESO received a total of ~ 800 applications for observing time with the fifteen telescopes at La Silla, involving almost 1000 astronomers. Three times as much time was asked for as is actually available and it was therefore only possible to accept ~ 350 observing programmes. Over 400 astronomers travelled to La Silla, and several hundred others also profited from these observations.

The scientific results from La Silla are discussed at numerous scientific and technical meetings, many of which are sponsored by ESO. The resulting Conference Proceedings, together with Scientific and Technical Preprints, Notes and Reports published by ESO, as well as the quarterly ESO house journal "The Messenger",...
serve as efficient carriers of new and exciting information, stimulating research in many places.

Since 1980, when the ESO technical and administrative sections moved together in the new Headquarters building in Garching near Munich, the central position of ESO in European astronomy has become even more pronounced. For the benefit of future generations of scientists, ESO has Fellow and Research Student Programmes in which younger astronomers spend 1 to 3 years in Garching or La Silla. Together with the staff astronomers and long- and short-term visiting scientists, they contribute to the intensively productive research atmosphere at ESO. Here is also the Hubble Space Telescope European Coordinating Facility (HST/ECF), jointly operated by the European Space Agency (ESA) and ESO.

A steady stream of visitors make use of the measuring machines and image processing facilities in Garching. There are currently two ESO-developed systems, IHAP and MIDAS; the latter is run under VMS on two VAX 8600 computers and many high-power workstations (Sun, Stellar). The Unix-compatible version of MIDAS has been exported to more than 100 other scientific institutes around the world, including several in the USA, the USSR and P.R. China.

IV. Technology at ESO

Confronted with the need to push the observational horizon further back in space and time by means of larger telescopes, ESO engineers realized nearly 15 years ago that in order to be cost-effective, future giant telescopes must be radically different from the existing ones in the 4 to 6 metre class. Until now, reflecting telescopes have been passive in the sense that the telescope mirrors are stiff and keep their form when the telescope moves. To retain this principle for larger mirrors would lead to excessive mirror masses and consequently to enormous, very expensive telescope structures. The concept of active optics has therefore been pursued at ESO, first by means of a series of extensive tests with a very thin 1-m mirror during 1986-87. Made of Zerodur, a zero-expansion ceramic material, and with a thickness of only 19 mm, this mirror was kept in optimal shape by computer-activated supports. The effort that went into the development of the necessary software was very substantial, because the programme must be fast and should be able to cope with all kinds of optical deformation.

A similar system has been successfully incorporated into the New Technology Telescope, which has a mirror of 3.58 m diameter, only 24 cm thick. Tests in the optical shop and, since March 1989 during actual astronomical observations, have fully confirmed the "active" concept and have demonstrated the superiority of this technique over all "passive" supports. Since the telescope "tunes" itself continuously, it always collects the incoming light as efficiently as possible, reducing the necessary observing time and allowing observations of fainter objects than with any other ground-based telescope.

Further optical work at ESO is now directed towards the development of adaptive optics which will allow the partial elimination of image degradation by atmospheric turbulence ("seeing"). This is done by means of small, flexible mirrors with very fast reaction time, situated near the image positions in front of the auxiliary instruments. To test this concept in practice, an advanced device with a 19 actuator deformable mirror, a Shack-Hartmann wavefront sensor, a wavefront computer and associated hardware was designed and constructed in collaboration with French institutes. It was very successfully tested at the 3.6 m telescope in April 1990, enabling this telescope to reach its diffraction limit in the infrared L band (3.5 μm). Over many hours of observation, space-sharp images (0.22 arcsec FWHM) were obtained and testified to the efficiency of this system. Even at the near-infrared wavelength 1.2 μm, 0.3 arcsec images were routinely produced. Sharper images not only means that more details can be observed; due to the higher light intensity in the concentrated image, fainter objects can be observed than before, or the exposure time can be correspondingly reduced for brighter objects. An improved device is now under construction, which will work at still shorter wavelengths, approaching the visual region. It will serve as a prototype for the VLT adaptive optics system, to be installed at the end of the 1990's in order to fully exploit the potential of this telescope.

After initial trial runs, a permanent communication link was established between ESO-Garching and La Silla in July 1987, via an Intelsat satellite in geosynchronous orbit and a microwave link. During day-time it is used for telephone, telex, fax and computer-to-computer connections, but the main interest lies in the night-time use: it incorporates the world's first system for fully interactive remote control of ground-based telescopes.

Astronomers now regularly perform observations from Garching with two of the La Silla telescopes, the Max Planck/ESO 2.2 m and the 1.4 m CAT, 12,000 km away. Via the link the remote observer points his telescope, verifies the field of observation by return TV-picture, centres the object to be observed, sets up the instrument configuration (filters, slits, exposure sequence, etc.), guides during the exposure and receives the digitized spectra or direct (CCD) images at 12 kband. These data can be immediately reduced by means of on-line image processing software, so that the observer is always kept informed about the quality of the observations and can take appropriate action, if something "interesting" turns up. A 64 kbaud digital link has also been installed and is used for remote observations with the NTT.

Active optics and remote observing are just two examples of the new telescope technologies. The 3.5 metre New Technology Telescope incorporates a new design of the telescope dome, in order to ensure better "seeing" by elimination of atmospheric turbulence within the dome. This is achieved by a wind-tunnel tested octagonal dome shape and active thermostatic control of all sources of heat, including the hydrostatic oil pads on which the telescope moves.

From the moment of "first light" in March 1989, the NTT has delivered the sharpest images ever obtained with a large ground-based telescope, thanks to the attention to technological details mentioned above. To reduce maintenance and at the same time increase reliability, the NTT has fixed instrumentation at its
Observational options. IRSPEC will increase, in particular due to Nasmyth foci: the multi-mode EMMI instrument and the infrared spectrograph IRSPEC are being permanently mounted and give the user a complete choice of observational options.

The NTT clearly inaugurates a new epoch in optical telescope design and with the added possibility of remote operation from Europe, the observing efficiency will increase, in particular due to flexible scheduling. When the astronomers no longer undertake strenuous travels to South America, their observing periods can be of any length, even a fraction of one night. With several programmes on simultaneous stand-by, it is always possible to select the one which is best suited to the momentary observing conditions (e.g. seeing, transparency), as recorded by adjacent meteorological instruments.

V. The 16 m Very Large Telescope

The present activities at ESO cover a wide spectrum, but there is little doubt that the 16-metre VLT project will occupy much of the ESO potential during the coming decade and also thereafter. This enormous undertaking represents a natural next step in a long development, and is a logical result of the current renaissance in ground-based astronomy.

The eight ESO member states decided to embark upon this project in December 1987. The project is fully financed by these countries at a level of 382 million DM, and it aims at the construction of an array of four 8.2-metre alt-az telescopes with an equivalent diameter of 16 metres. The decision about the site will be taken in late 1990; it will either be next to La Silla or further north in the Atacama desert, where thorough investigations have indicated an even larger number of clear nights. The first 8-metre unit telescope will become available in 1995; all four telescopes should be ready in 1998 and full integration is expected by year 2000. There will be four basic operation modes: 1) Independent observing of different objects with the four telescopes; 2) Simultaneous observing of same object with several telescopes; 3) Combined mode, and 4) Interferometric mode. There will be a total of 17 foci, most of which will have fixed instruments with the possibility of rapid switching between modes and foci. The interferometric option is still under development; it will allow angular resolutions of the order of 0.5 milliarcsecond, unequalled by any other ground-based optical facility.

The instrument package for the VLT is still under discussion, but it will most probably include faint object spectrographs, medium-to-high resolution fibre spectrographs, multimode infrared imaging spectrometers, various infrared cameras optimised for different atmospheric windows between 1 and 26 μm, a very-high dispersion spectrograph at the incoherent combined focus and a long-baseline interferometer at the coherent combined focus.

The project is supported by the experience from the NTT; this telescope is in fact a pre-study for the Very Large Telescope. The scaling factor from the 3.5 metre NTT mirror to the 8.2 metre unit telescopes is 2.3, a reasonably conservative step in engineering science. Still, the VLT project represents a major technological challenge, especially what concerns the manufacture and maintenance of the very large mirrors.

V. Science at ESO

Research at ESO greatly profits from the advanced technology described above, allowing complicated spectral and photometric observations to be performed in an light-efficient and time-saving way. The observational programmes represent a broad section of current front-line astronomy.

In view of the enormous observational activity at La Silla, there is hardly any bright object in the southern hemisphere that has not been looked at. The programmes range from long-term monitoring of variable objects to dramatic one-shot sessions; few, if any, have failed to increase our knowledge, and many have brought exciting discoveries. In 1989, the concept of Key Programmes was introduced, i.e. very comprehensive observing projects to which large blocks of telescope time are allocated; this facilitates surveys of faint objects and also allows to tackle fundamental problems, which require much statistical data. The results are published in the professional journals and, whenever speed is important, in the IAU Circulars; during the past years, ~10% of all Circulars issued have carried information from La Silla.

The scientific output from La Silla and Garching closely reflects the progress in optical astronomy and it is obviously impossible to give a comprehensive overview of the many individual programmes, but here are some highlights.

Solar system research at ESO includes a very productive minor planet programme during which several thousand new objects have been discovered; some of these are of the rare Apollo-type. Preliminary orbits have been calculated for several hundred of them and accurate light curves of many numbered planets have been measured for the determination of rotational parameters. Photometric and spectroscopic observations have been made of several satellites of the outer planets, including the Pluto-Charon system. Stellar occultation photometry has contributed to our knowledge of the ring systems of Uranus and Neptune. Minor planet Chiron, recently turned comet, is being studied with deep CCD exposures. Imaging and spectroscopy of comets is done with various instruments; several new comets were discovered at La Silla. Comet West (1976 VI), one of the brightest comets during this century, was found here. And P/Halley, the most famous comet of all, is still being monitored, more than 14 AU from the Sun.

The investigation of the stellar component in the Galaxy has always had a prominent place at ESO. Large-scale photometric programmes are carried out with the smaller telescopes, for instance a survey of all A and F stars brighter than apparent magnitude 8.5 by means of the extended “Strömgren” photometric system uvby + Hβ. This has resulted in the determination of the physical parameters of these stars with unprecedented accuracy, in particular the absolute magnitudes and the metal content. When combined with accurate radial velocities from the CORAVEL automatic instrument, these data have served as an important base
for studies of galactic structure. Other photometric and spectroscopic observations have led to the discovery of many binary systems, for which the physical and geometric characteristics were determined from light curves and radial velocity curves.

Medium dispersion spectroscopy has contributed to the identification of a number of extremely metal poor stars in the galactic halo and seismological studies have been made of some of the brightest stars in the southern sky by means of very-high spectral resolution (R ~ 100,000). Lunar occultations and speckle techniques have resolved the disks of some supergiant stars.

By means of rapid photometry, optical bursts and flashes have been observed from some galactic X-ray and γ-ray sources. During one observing season, a particular source was monitored automatically over no less than five months. Some of the events, however, may have been caused by satellites or orbiting debris passing through the field of view. The increasing pollution of space has become a subject of major concern to observational astronomy.

A central theme in modern astrophysics is the evolution of stars; great observational and theoretical progress has been made in recent years. Observations at La Silla have led to the discoveries of many stellar “nurseries”, as well as old stars now nearing the end of their lives. New “jets” have been found near young stars, still in their natal clouds, and the associated accretion discs are objects of intensive observational studies with infrared and submillimetre techniques.

Although the interstellar matter in the Milky Way Galaxy is only responsible for ~ 10% of its mass, the study of this medium is rapidly becoming a very central subject in astrophysics. This is partly due to the realisation of the intimate connection to the stellar component through the stellar cycle of life, during which material processed in stars, and enriched in heavier elements, is deposited in interstellar clouds and later incorporated into stars of the next generation. The field of astrochemistry deals with the complex processes in the interstellar medium, on the surfaces of icy grains which are bathed in intense ultraviolet radiation from hot stars. This exciting area of modern astrophysics is profiting from observations at La Silla which is ideally situated for the study of the complex regions near the galactic centre that passes directly overhead.

The SEST instrument on La Silla is the first of its kind in the southern hemisphere and many programmes have been started during the past years. Interstellar studies play a prominent role and, among others, a detailed mapping of millimetre radiation from organic molecules in interstellar clouds near the galactic centre and elsewhere is now in progress. New organic molecules are being searched for, but observations of the CO molecule are of particular importance, because of its high abundance in objects of various types and its strong emission in the millimetre spectral region. CO-maps have been made of low-mass and high-mass star-forming regions, as well as of cometary globules. The CO molecule has also been used as a tracer of the H₂ molecule in the outer regions of the galactic disk, showing for the first time that the molecular clouds partake in the galactic warping. The innermost area around the Milky Way centre has been imaged at high spatial resolution with prototype two-dimensional infrared detectors. Quite a number of cometary globules and hitherto unknown Herbig-Haro objects have been found on deep Schmidt plates and CCD exposures. The observations of very weak absorption lines in the spectra of bright stars, for instance of 12 CN, has made it possible to measure the isotopic ratio in the interstellar medium and also the temperature of the microwave background radiation.

Deep down in the southern sky, and therefore not accessible for observations with northern hemisphere telescopes, two satellite galaxies to our Milky Way, the Large and the Small Magellanic Cloud (LMC and SMC), have been the subject of a great variety of observing programmes from La Silla. They represent the first “stepping stone” towards the outer universe for many cosmological studies and they are of crucial importance for the calibration of many distance indicators.

Objective prism surveys at La Silla have given spectral types and radial velocities of the brighter stars in this sky area, thereby separating the LMC and SMC members from the galactic foreground stars. Measurements of the chemical composition of the brightest stars in the Clouds have revealed important differences when compared to galactic stars, reflecting different evolutionary histories. The structure and dynamics of supernova remnants in the LMC have been studied and the central region in the giant H II region 30 Doradus was resolved into a cluster of densely packed, hot stars. Globular clusters of very different ages outline the changing star formation rate during the past 10⁶ years.

One particular star in the LMC of which objective prism spectra were obtained at La Silla in the 1970’s, exploded as Supernova 1987A in February 1987; since then it has been observed from ESO with virtually all available techniques. Whereas ultra-fast photometry did not (yet) confirm the presence of a central pulsar, infrared photometry in 1989-1990 has shown that there must be a central source of energy, probably a new-born pulsar. Observations with an infrared spectrograph (IRSPEC) provided for the first time a detailed spectrum in the 1 - 5μm spectral region of a supernova. Very-high resolution spectroscopy with the Coude Echelle Scanner showed a large number of intervening gaseous clouds, several of which are in the intergalactic space between the Large Magellanic Cloud and the Galaxy. The evolution of a number of surrounding “light echoes” has been followed over the past years.

Much research at ESO has concentrated on the highly energetic centres of “active” galaxies, thought to harbour black holes. Observations of the central accretion disks in the nuclei of some Seyfert galaxies and their temporal brightness and spectral variations have significantly strengthened this hypothesis. Several galaxies with redshifts above 2 have recently been found and spectroscopically confirmed with the NTT.

Many southern clusters of galaxies have been found on deep ESO Schmidt plates and on long CCD exposures in red and near-infrared light. For evolutionary studies, multicolour images have been obtained of distant and mainly compact clusters with the EFOSC instrument. The spectra of the individual galaxies in these clusters are observed simultaneously by multi-slit techniques with the OP-
TOPUS adapter at the 3.6 m telescope. Of particular promise in this field are new observations with the EMMI (ESO Multi-Mode Instrument) which was installed in June 1990 at the NTT. It is by far the most complex and efficient optical auxiliary instrument ever built and it allows the astronomer to observe even very faint objects, directly as well as spectroscopically. Limiting magnitudes around 28 - 29 will be routinely reached for direct imaging in a few hours' exposure, once EMMI has been fully tuned.

The most distant, individual star ever recorded was detected at La Silla in August 1988. The object is a supernova in an inconspicuous galaxy, itself a member of a distant cluster of galaxies at a distance of about 1.5 Gpc. This supernova was apparently of Type I, and many supernovae of this type have been observed in nearby galaxies. The detection of more such objects would enable us to verify the reliability of supernovae as cosmological distance indicators. Moreover, distant supernovae may be used as "clocks" to check the time dilation predicted by the General Theory of Relativity. A survey programme, aiming at the detection of other distant supernovae, is under way with the Danish 1.5 m telescope at La Silla.

The effect of gravitational lensing by clusters of galaxies has recently opened new, exciting vistas in optical astronomy. Several of these newly discovered "arcs" and "arc segments" are under study at ESO. Thanks to the light gathering efficiency, in particular of the NTT, it has been possibly to obtain rather detailed spectra of some of them, confirming their nature.

The study of quasars is also actively pursued at ESO. Quasar candidates, found during dedicated photometric surveys, are verified spectroscopically. The CASPEC instrument has been used to obtain high-resolution spectra of quasars, also for the investigation of absorption lines from intervening clouds. This is of great importance for studies of the structure of the universe and of the presence of matter in intergalactic space. For instance, this instrument obtained a very high-resolution spectrum of one of the most distant quasars known, Q0009-26 at redshift z = 4.11. Spectral lines were detected from material near the quasar as well as from several hundred intervening objects, including an apparently normal galaxy at redshift 3.39.

Due to recent improvements in the achievable angular resolution, because of better control of the telescope "seeing" and by improved image processing techniques, the ongoing search with La Silla telescopes for double images which may be either gravitational lenses or binary quasars has been rather successful; objects of both classes have now been found.

VI. Outlook

Optical astronomy is in a phase of rapid development, as shown by the examples of recent research projects with the ESO telescopes, outlined above. Thanks to better observations, the interpretation of many phenomena has taken great strides forward during the past few years.

With access to the extensive facilities at La Silla and in Garching, with the recent installation of the revolutionary 3.5 metre NTT, and with the prospect of the 16 metre VLT, the European astronomical community faces the future in high spirits. The available technological know-how and the great diversity of current front-line research will guarantee the best possible exploitation of this marvellous new instrument. VLT-based science will be an essential complement of Europe’s astronomical research activities from space vehicles. When the first of the four 8 m telescopes is ready by 1995, a great number of ambitious programmes will be started up. And when the entire array is in place in 1999, a new chapter in ground-based astronomy will open.

Together with their colleagues elsewhere, and in the true spirit of international collaboration, European astronomers can look forward to a wealth of exciting new information about the Universe in which we live.

Appendix: ESO Material of Interest to Planetarians

As the prime organisation for astronomy in Europe, ESO has gone to great lengths to produce written and pictorial material of interest to the public and science educators. But due to the small size of the organisation, the amount of available material is limited so far.

ESO's house journal, "The Messenger" appears four times a year, normally in March, June, September and December. It is sent to organisations and individuals interested in astronomy and describes new developments at ESO, for instance the evolving status of ESO's major projects, particularly interesting scientific results from the ESO telescopes, upcoming conferences, new ESO publications, the distribution of observing time, where the ESO exhibitions will next take place, etc.

The "Messenger" is published in English only.

ESO issues Press Releases about its activities; in the past years there have been about 6 - 10 per year. They are sent to media representatives who take an active interest in disseminating news about ESO.

During the past year, ESO has started to produce its own video films about astronomical subjects. The first of these, "Remote Control", explains why remote observing with telescopes at La Silla is useful, and how this is done in practice. Another presents the first images from the New Technology Telescope, and more are planned.

In the past, ESO has compiled various slide sets with spectacular (and astronomically interesting) views of objects in the southern sky. Some of these are out of print, but others will be made in the future. They are accompanied with extensive texts which enhance their educational value.

A set of posters is available. It is expected to produce a new set with particularly stunning views from the NTT in the course of 1991.

Finally, the ESO Exhibition gives a general introduction to science an tech-
technology at ESO. It covers about 250 m² and has been shown in most European countries. It is largely based on pictures with accompanying texts, but there are also models of the La Silla telescopes and an interactive “observational” display. The Milky Way panorama (8 x 1 metres) is particularly impressive. The Exhibition is normally booked 12 - 18 months in advance.

Please direct all enquiries to ESO Information Service, Karl Schwarzschild Strasse 2, D-8046 Garching bei München, Federal Republic of Germany. Kindly note that in view of the large number of requests received, we can not always guarantee a quick answer.

At the same time, all suggestions from experienced educators are of course most welcome.

CAN UNIVERSE BE DIFFERENT?
Peeter Enn Kukk, Rein-Karl Loide and Aadu Ott

The investigations in cosmology had raised many principal problems. These problems are mainly physical, but also philosophical problems exist. It seems that the universe where the creation of complicated structures is possible is similar to our Universe.

Our Universe is described by the well known standard model. The latter in turn confirms that the laws of physics we know are applicable in describing an early Universe where the micro and macro world are very closely related. In the existence of our Universe and observers in it an important role are playing the values of physical constants, masses and charges of elementary particles. It appears that slight changes of constants and masses lead to great changes and the world, we know, cannot exist. Consider, for example, the mass value of an electron. For an existence of H atom the mass of an electron must be less than the mass difference of neutron and proton. On
the other hand one cannot decrease the mass value of an electron, because then the stability of deutron is impossible. Therefore, if we change the mass value of an electron the appearance of complicated structures is not possible. The constant of strong interaction guarantees the existence of heavy nucleons. If the gravitational constant is a little bit greater there are no planets and the appearance of life in that universe is not possible. In spite of the fact that the modern cosmology allows the creation of different universes the universe similar to ours can exist if the physical constants, masses and charges are the same as in our Universe.

Are the different universes connected in some way, is an open question. The answer to it particularly depends on the dimensionality of space. From the laws of classical physics it follows that the ordinary space is three dimensional. In the microphysics the answer is yet open, because we do not know how the gravitational forces are connected with the other fundamental forces. There are no good quantum theory of gravitation. Nowadays the problem how the gravitation works at high energies is one of the central problems of modern physics. Trying to solve this problem there have been invented many promising new models, more interesting of which are string and superstring models. These new models cannot go into three dimensions and it seems that in the microworld the dimensionality of space is greater than in the macroworld. If it is so the different universes can coexist in this higher dimensional space-time and then some interaction between different universes is possible. Is this curious picture true, we do not know, because we also do not know whether the string and superstring models are too crazy to be true. Concerning the string and superstring models it should be noted that from the mathematical point of view the analysis of strings and superstrings can be reduced to the analysis of ordinary fields and therefore put into the ordinary field-theoretical language. From this point of view it seems that strings and superstrings are not yet the last word in physics. In conclusion should be remarked that the question put in the heading of our paper can be answered as follows: the universe which allows the existence of complicated structures and observers in it is similar to our Universe.

In order to visualize the concepts mentioned above, we intend to utilize the "Starlab" mobile planetarium in a project where East meets West, science interacts with humanity and didactics with the creative use of a planetarium. We want to follow the challenging content in the expression "The Boundless Planetarium".
THE NORTHERN LIGHT - AN INTRODUCTION TO THE TEACHING OF THE UNIVERSE

Jan -Erik Solheim

ABSTRACT

The Northern Light can be used as a case study of history of science - and how a phenomenon of nature is interpreted in different cultures and ages. It can also be a guide through modern physics and our present understanding of the Universe.

INTERPRETATION OF THE NORTHERN LIGHT - A HISTORY OF SCIENCE CASE

In the planetarium we can make interesting shows, displaying the Northern Light, and try to explain it in the framework of the physics of today. We can also make a tour in the history of natural science - trying to tell how this phenomenon has been described and interpreted during the ages. This is a fascinating journey. The description is always very lively and colourful, talking about winds and fire. If the display is red, it may be interpreted as flames from a celestial fire - or a burning city below the horizon.

For the Indians and the Eskimos living in the North, the colourful displays were related to gods and supernatural beings. Very often the heaven was the place for the spirits of the dead, and the light show is the dance of these spirits.

If we ask about explanation of the phenomenon, it is always given related to the science of the time. In old Greece it was interpreted as jumping goats, to be distinguished from the fixed star pattern and their celestial animals. Aristoteles presented the most elaborate theory in this book "Meteorologia": All non permanent phenomena on the sky were the same: comets, meteors, and Northern Light all had the origin in vapors coming out of holes in the earth, the heavy vapors give the water droplets, and the light vapors give the lights we see in the sky, filling the space from the Earth to the Moon. The violent phenomena we observe are reactive mixtures of the four main elements fire, air, water and earth.

Before we proceed to the more modern times we must quote a description of the aurora given in a thirteenth-century Norwegian chronicle "Kongespeilet":

> These northern lights have this peculiar nature, that the darker the night is, the brighter they seem, and they always appear at night but never by day, most frequently in the densest darkness and rarely by moonlight. In appearance they resemble a vast flame of fire viewed from a great distance. It also looks as if sharp points were shot from this flame up into the sky: these are of uneven height and in constant motion, now one, now another darting highest, and the light appears to blaze like a living flame.

Many famous astronomers and physicists have tried to explain the Northern Light. Since we are in a Nordic setting we must mention Tycho Brahe, who observed the Northern Light from his observatory at Uranienborg on the island of Ven. He observed the location of the auroral corona, which later could be used to determine the magnetic inclination of his observatory. Galilei mentioned the Northern Light with the Latin name: boreale aurora - "the northern light of dawn" - a rather misleading term - which we have kept.

Another famous astronomer - sir Edmund Halley, lived in a period of meager solar activity. He once said: "I would die to see an aurora but will probably die without seeing one". He was lucky and saw the great aurora of 1721 - and became the first scientist who presented the idea that the aurora is related to magnetic activity - or magnetic fluids leaking out at the poles of the Earth.

When the aurora again became frequent in the eighteenth century, many books and papers were published on the subject in the Nordic countries, but none created more sensation than the treatise of professor Anders Celsius in 1733. The title was "316 observations of the Northern Light made in Sweden from 1716-1732". He discussed the many fantastic and ingenious explanations of the Northern Light which had been proposed in his time, but concluded that "it is de-
plorable that the Northern Light still has not let itself be tamed by the scientific community. He emphasized that all speculations should be distrusted, and reminded his contemporary scholars that to understand true natural phenomena they should forget about speculations and rather endeavour to make accurate observations. He thought that future scientists would commend his colleagues far more for accurate recordings of observed Northern Light than on wild speculations. Celsius was professor in Uppsala and founder of Uppsala observatory, and this became a center of auroral research for some time.

One remarkable series of observations was done by Olof Peter Hiorter, lecturer at Uppsala University. Celsius had suggested a relation between the position of the compass needle and the Northern Light. Hiorter placed the compass needle on the table in his room and watched it day and night, every hour for one year – and was able to prove a correlation between the position of the needle and the auroral activity – an experiment which very well can be built into the classrooms today. He also discovered simultaneous observations of Northern Light over Northern Scandinavia, Northern Asia and North America at the same time, which led to the conclusion of the existence of a luminous ring around the magnetic poles of the earth.

Today we have a much better understanding of the aurora, and know that it is related to charged particles blowing from the Sun, interacting with the Earth's magnetic field. We have observed it from space, and we have measurements in situ of the magnetic field embedding our planet.

TEACHING THE UNIVERSE – STARTING WITH NORTHERN LIGHTS

In Tromsø we have in the last few years been teaching a course for students of natural science about the near and distant Universe – starting with the aurora and its interpretation during the ages. Special emphasis is given to the great breakthroughs early in this century due to famous Norwegian physicists: Kristian Birkeland with the idea of an Earth ring current system and the charged particles from the Sun, Carl Stormer and the painstaking observations of the altitude of the aurora, and Lars Vegard with his big spectrographs to explain the colours of the light.

Then we teach the explanation based on today’s physics – leading up to the Dynamo model for the Aurora (Akasofu, 1989). This brings us in touch with plasma physics, physics of the atmosphere, quantum mechanics – especially "forbidden lines – collisionally excited" – and the relations between the Sun and the Earth. We then ask the question: Do the other planets have aurora? – and we study the observations from Voyager and the other space explorers, and indeed find auroras on Jupiter, Saturn, Uranus and possibly Neptun – the necessary requirement being that the planet has a magnetic field and an atmosphere of some dimensions.

We then leave the solar system, and ask if other stars behave like the Sun and blow a wind on its planets, and indeed we find stellar
winds on all scales, from rather modest from our sun to rapid atmosphere losses of Wolf-Rayet stars or stars in binary systems, where gravitational pull accelerates the process. In extreme cases we have strongly magnetized white dwarf stars in cataclysmic systems, where the acceleration of particles down the magnetic field creates pulsed energy burst we observe as X-rays.

Finally we notice the strong energy release process in rotating neutron stars (pulsars) and the processes associated with black holes and active galaxy nuclei, and must conclude that the process creating the Northern Light is everywhere in the Universe, probably also present in the beginning - the hot big bang itself.

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PAW OF THE POLAR BEAR
Tom Callen

ABSTRACT
Considering the wide variety of cultural depictions of the night sky, it is not surprising that the Chukchee and Koryak Eskimos of Siberia would have a rich sky lore of their own. This paper concerns highlights from constellation research involving two Koryak shaman’s parkas that was performed in the Albert Einstein Planetarium.

INTRODUCTION
In the late summer of 1988 anthropologists from the Smithsonian’s National Museum of Natural History and Johns Hopkins University contacted me about two ceremonial Eskimo parkas that depicted what they thought might be star patterns; the anthropologists wondered if perhaps I could help try to identify them. After taking a look at the garments in their storage area at Natural History, I agreed to help out due to a long standing interest in archaeo- and ethnoastronomy. It also looked like an interesting challenge.

STAR PATTERNS FROM OTHER TIMES AND PLACES
Being planetarians, the idea that diverse cultures have different representations of constellations is not a new concept. There is ample evidence that others beside our Greco-Roman cultural ancestors created such entities out of the apparent jumble of stars overhead. 

Ursa Major is a perfect example of a constellation seen differently by different people at different times. The least abstract, and the one we are the most familiar with, is the Big Dipper. Another familiar representation, particularly to native North Americans, is that of the Big Bear. Crossing the ocean to Europe, and we find several other variations, including Charles’ Wain of France, and the English plough. Shifting our location to the far east, and we note that the ancient Chinese saw an Emperor and his servants. Making a final leap in both location and time, we find that certainly the most abstract interpretation is that of the ancient Egyptians who recognized a bizarre collection of creatures.

THE SHAMAN’S PARKAS
The two anthropologists had been studying a number of Eskimo parkas in preparation for their symposium paper on the art of costumes of the North Pacific. Such garments are made by the women of the group out of animal skins, like elk and seal, which then are decorated with a variety of items, such as seal fur, hide tassels -- that not only accentuated the motions of the wearer, but also were used to ward off spirals -- small glass beads, and metal items purchased from Soviet, American, and, in the case of North American Eskimos, Hudson Bay Company traders.

My involvement dealt with trying to interpret two Koryak shaman’s parkas, which I’ll refer to as the Beaded Star, and White Star. Parkas. One thing that both of these garments have in common is that they are covered with a variety of circles, which is known to be a Koryak
decorative motif for stars. The mystical shaman would take trips to the upper worlds, stars and constellations providing a way for them to find their way to these sacred places. The diameters of the star images on the two parkas may or may not have a correspondence to brightness. It is traditional in western celestial cartography to denote the brightness of stars in terms of diameter; the larger the diameter the brighter the object. Looking at these two parkas, there does not seem to be a representational relationship between star diameters, but rather a cultural, or religious, one as stars tentatively identified by their positions that are bright in the sky and would therefore have larger diameters are not necessarily so on the parkas.

THE BEADED STAR PARKA

We can only briefly consider the Beaded Star Parka as it only has one tentatively identified item of interest; a large, beaded roundel made up of concentric rings of white, black, red, maroon, green, pink, and blue colored beads on the Parka's back. This may be the sun, known as the "Supreme Being," as it strongly resembles a known sun image on an Eskimo drawing showing the daystar at dawn, and because it is the largest of any worked ornamental feature on either garment.

THE WHITE STAR PARKA

This garment is much more interesting to us as planetarians due to the potential for identifying some actual constellations on it. There are known examples of Eskimo star maps which have features, such as Ursa Major, Polaris, the Milky Way, the Pleiades star cluster, and Orion, concretely identified on them. Through various sources, I have been able to find some 25 to 30 discrete references to either stars, constellations, sun, moon, planets, comets, and meteors, so it is a fairly well established fact that these people had a rich sky lore.

THE IDENTIFICATION PROCESS

The first step to my tentatively identifying any constellations on the shaman's White Star Parka was to use the Albert Einstein Planetarium's Zeiss star projector and set up the night sky -- to between 62 and 64 degrees north latitude -- and duplicate what the Koryak themselves would have seen. For a North American city, this is the equivalent of being just a little south of Anchorage, Alaska. The next step was to compare photographic prints of the parka with major star groupings that looked like they might be probable candidates for matching the parka, but that were also figures known to the Eskimos. This wasn't very successful until I realized that we were orienting the pictures the wrong way. In fact, what confirmed it for me was an astronomical sweatshirt that I had bought earlier that same summer at IPS '88 in Richmond, Virginia. When you look at someone wearing this sweatshirt, the star map is not very useful as it's oriented upside down. It's actually printed so that it is useful to the wearer, which is exactly how the patterns turned out to be on the White Star Parka, which made sense as the shaman was to be using it as a road map to find his way to the upper worlds in the heavens. At this point, I started to make what I feel are some good, tentative identifications between the planetarium sky and the patterns on the White Star Parka.

SOME PROMINENT FEATURES OF THE WHITE STAR PARKA

One of the most prominent features circling the waist of this parka -- taking the form of a very distinctive pattern of fabric -- is the Milky Way, which is known to the Eskimos as the Pebbley River, Clay River, or Muddy River. This "Milky Way as river" motif is reflected in constellations along its length, such as the five reindeer taking a drink out of the Pebbley River (Cassiopeia), the Seal Hunter in his Kayak (Cygnus), and the Seal (Delphinus). That this patterned band on the parka was the Milky Way was easily confirmed via an Eskimo star chart which has the Milky Way identified on it as the wavy line running across its center. Three identified figures on this same map, the Milky Way, Polaris, and Two Elks, almost exactly match groupings on the back of the White Star Parka. Based on their corresponding positions, these designs must also be the Pole Star, and the Two Elks, which is the equivalent of the Greco-Roman Gemini. Unfortunately, these are the only two identifications I can make on the back of the White Star Parka at this time.

Moving around to the front of the White Star Parka, we find another reference to the Milky Way, which also helps to confirm the hypothesis that the patterns on the parka are to be understood by the wearer, but not the casual observer. An interesting feature on this side of the garment is a vertical strip of Milky Way-pattern cloth with a large star spot at its end. What could this be? As it turns out, from the range of latitudes frequented by these Eskimos, the winter Milky Way rises almost perpendicularly from the horizon next to Sirius, the brightest star in the night sky.

Sketch 1: Front of White Star Parka
1. Orion, the Hunter
2. Tarazed (Aquila, the Eagle)
3. Altair (Aquila, the Eagle)
4. Alshain (Aquila, the Eagle)
5. Vega (Lyra, the Harp)
6. Summer Milky Way
7. Winter Milky Way
8. Sirius (Canis Major, the Big Dog)
9. Pleiades star cluster (Taurus, the Bull)
10. Cassiopeia, the Queen
The first actual constellation to be identified on the White Star Parka was that of the Archer with the Crooked Back, otherwise known as Orion. This mighty hunter is just as fanciful a character in Eskimo legend in spite of his deformity as he is in Greco-Roman mythology, and makes for an interesting story involving both spring and winter constellations. Leo marks Standing Woman, the wife of the Crooked Back Archer: one day she hit him with her tailoring board, which caused his back to become bent. He drove her away, and she lay down to sleep on bare ground in the middle of the sky. Looking for female companionship, Crooked Back Archer spotted a group of six young women, personified by the Pleiades star cluster, who were waiting for suitors to come along and marry them. Unfortunately, his outstanding manliness (use your imagination) scared them, and they refused his amorous advances. Spurned, the sturdy hunter did the only thing that he thought would save his wounded pride; he began to shoot arrows at them from his bow. Fortunately, there was a net, represented by the Hyades star cluster, between Crooked Back Archer and the maidens that protected them from his deadly shots. We can still see the head of one of his copper-tipped arrows, ruddy Aldebaran, caught in the net to this very day.

A final identification, which I feel pretty confident about, deals with two groups of stars that straddle the Milky Way band on the left front (as seen by the shaman) of the White Star Parka. On the top side we see three stars in a row with a larger-diameter star in the center, while on the lower side there are several stars with a larger-diameter star offset from the Milky Way. Other than the three stars that make up Orion's belt, what three well-known stars in a row come to mind. For me, it was the three stars Altair, Tarazed, and Alshain, which mark the tail of Aquila, the Eagle. And, looking northeast across the Milky Way, our eyes are naturally drawn to a brilliant blue-white star -- Vega, in Lyra, the Harp -- at about the same distance from the hazy band as Altair. Altair and Tarazed are recognized by the Chukchee as making up the heavenly "forefather of the tribe who ushers in light of a new year," while Vega is known as the Rear Head, a star used for navigational purposes -- along with Polaris and Arcturus -- while traveling across the open tundra.

THE PAW OF THE POLAR BEAR
In closing, let me mention just one more Eskimo grouping; the one that led to the name of this paper. If you were an Eskimo, you wouldn't have much use for something as impractical as a jewel-encrusted crown. You would, however, know all about polar bears, or in this case, the paw of the polar bear, which is what the Eskimos know Corona Borealis, the Northern Crown, as. Rather than a circlet of gems, each star marks a sharp claw on this bearless paw.

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A new generation telescope that will dominate astronomy in the coming century has been proposed by two universities from the States. The University of Texas at Austin and Pennsylvania State University have proposed an innovative, powerful, and yet inexpensive telescope to be known as the Spectroscopic Survey Telescope (SST). This major instrument will be built and operated at the McDonald Observatory in Texas.

Astronomy has furnished the clues that have unlocked the mysteries of the other sciences, which in turn, have produced rewards beyond the imagination of the astronomers who provided the clues. Astronomers know they have barely opened these mysteries of what there is to be observed. For one thing, energy-release mechanisms can be seen which appear more powerful than can be explained satisfactorily by today's science. More observatories with much more powerful instruments are needed to pursue these mysteries. The Spectroscopic Survey Telescope will explore these vast reaches of space and time, and make discoveries which cannot yet be named because they have not been imagined. Because of its superior light-gathering ability and because it is devoted solely to spectroscopy, it will be the most powerful telescope in the world for many spectroscopic projects!

Unlike traditional multipurpose telescopes, the SST is designed to minimize costs while maximizing efficiency of a single function. It will collect more light to study fainter objects in greater detail, yet do so in a way that is affordable. It will consist of 85 easily fabricated spherical mirrors, each about 40-inches in diameter and 1.5 inches thick. All of the mirrors will be arranged in one large framework so that they can align to a common focus, forming one large mirror. Each mirror will be figured to an extremely shallow spherical curve and will provide an effective aperture of 320-inches, making the SST among the new large telescopes of the coming century. This multiple array of mirrors will be an innovative light-reflecting surface for the telescope.

A major design breakthrough will come in the area of aiming and moving the telescope. All previous large telescopes have had to move their entire mass in order to keep pace with the apparent motion of celestial objects. The SST avoids this problem by remaining fixed in position while it is trained on an object in space. The sighted object will be tracked by a movable assembly at the top of the telescope. The SST is designed to maintain a fixed elevation at 30-degree angle to the vertical. This will eliminate the problem of varying stresses of gravity on the mirrors and main telescope. While its vertical position will remain fixed, the telescope will rotate horizontally on a turntable, which will allow it to swing to and lock at any position in azimuth. These simplifications greatly reduce the cost of the mirrors and telescope tube while giving the telescope access to more than two-thirds of the sky visible from McDonald Observatory.

Another design feature concerns the instruments which give the SST its power to explore the Universe. The telescope's two spectrographs are designed to be fed by optical fibers. This enables them to be separated from the telescope itself thus freeing the telescope from unwanted weight. The spectrographs will be located in a separate temperature-controlled room. Their separation from the telescope permits the construction, operation, and maintenance costs to be kept to a minimum, while allowing maximum flexibility for future modifications.

But probably the best part of all is in the final aspect that will make the SST uniquely effective - the problem of scheduling for the use of the telescope. Instead of turning the telescope over to a single astronomer for a whole night a variety of
projects can be conducted at one time. A computer will create an interleaved schedule of target objects, chosen from many individual projects, and the SST will examine each object in turn as the night sky sweeps overhead. This will make the SST extremely efficient and will give it an extra advantage as well since it will enable the SST to be dedicated to long-term projects that are impossible for telescopes scheduled in the previous way, due to the demands. This capability to pursue long-term projects without displacing other projects will be a plus in the SST’s unique capacity for success!

The Spectroscopic Survey Telescope is to be located in far West Texas at the McDonald Observatory of The University of Texas at Austin. Studies of atmospheric conditions at McDonald, and more than half a century of high-quality observations made in its dark skies, have shown it to be an outstanding location for optical astronomy. McDonald ranks among the top ten observatories in the world, and is one of the few left in the States with truly dark nights.

An agreement between the astronomers at the University of Texas and Pennsylvania State University has named Dr. Larry Ramsey, of Penn State, to be acting Project Manager for the design phase of the project. All parts of the telescope are now designed to the extent necessary for accurate cost analysis. The basic design concept of the instrument allows the elimination of the calibration and alignment tower and the parallactic ring, which will save significant amounts of money. The testing of the pyrex mirrors at Penn State is allowing for the planned spherical abbreviations and, out of the twenty mirrors, six have been accepted as of this writing. The SST is an observational facility and this testing of each mirror in its support cell at the 30-degree angle is of the utmost importance.

The Spectroscopic Survey Telescope can be built on time, dedicated four years after constructions begins, for a cost of less than $8.2 million and will perform as advertised!
ABSTRACT

Amongst all living beings of our earth, man is different from the rest because of his civilization. This human civilization stems from and derives its main sustenance from science. For, after all, Nature is supreme, there is no bypassing it; and it is science that enables man to bargain with Nature. It so happens that the most revealing and far-reaching findings about Nature have come to man through his study of the sky — from the hoary past down to recent times.

INTRODUCTION

No thoughtful person will disagree that man is what he is today primarily because of his science. Other things have been there too, playing or having played important roles — literature, religion and such others. That is but natural; for, as has been aptly indicated in the Bible, man does not live by bread alone. But surely bread — or what it connotes — comes first. So also with science. It is science that laid down the foundation for human civilization, setting him apart from other living beings of the earth. It is science that has taught and is still teaching man how to come to terms with all-powerful Nature gainfully, how to survive its vagaries or vicissitudes and eventually how to flourish. And, quite significantly, a very good part of this science — a part vitally important for his own progress, and also for the progress of his science — man has got by critically studying the sky.

PREHISTORIC DAYS

Ability to measure time and to frame a calendar must be regarded by everybody as two of the most important prerequisites and also of the most outstanding achievements of man as he set out to attain civilization. For these, in the beginning at least, man was entirely dependent on the sky. Day, month, year — these basic units of time were all gifts of the heavens. But they did not come to man like manna dropping from above — he had to study the sky painstakingly and perseveringly to get them. Had not the primitive man observed
some changes taking place in the sky — systematically and cyclically— he would not have been able to tame time and win the race. To name but one thing only, agriculture would have been impossible without the assistance of a calendar. And the calendar that he devised, man had to revise several times subsequently — the intercalary month, the leap year, the Julian calendar, the Gregorian calendar have all their tales to tell; and all these came from man's study of the sky and his needful efforts to associate his observations there with what happened around him. The clay tablets excavated from Babylon, the Stonehenge in Britain, the Sothic year and Sothic cycle of ancient Egypt, the Chaldean Saros, the Metonic cycle are but a few reminders to us now as to how much labour and patience our distant forefathers had to use to improve their calendars, and how that was achieved by means of sky-watching.

Another major need of man, in the days of yore, was also set by the sky — determining his bearings and indicating the directions. That man could go to different parts of the globe with confidence and then safely come back again, according to requirement, is certainly one big reason why he dominates over it. And that, for many many years, he could do principally depending on the sky — noting the movements of heavenly bodies across the sky, and their relative positions and orientations. In fact, later in human history, accurate determination of geographical latitudes and longitudes were all done by watching the sky.

For many centuries, the sky was indeed to man his clock, calendar, compass and map — all rolled into one.

A LATER PERIOD

Man started making himself anew and in a very big way around the early part of the 17th century when modern science was aborning — bringing forth, behind it, unthought-of technologies based on his new concepts of mechanics. This new age was ushered in by people like Galileo and Newton and these path-breaking scientists heavily drew upon the wealth of data collected from the sky by great sky-watchers like Tycho Brahe and Kepler. It is interesting to note, in passing, that in these days man was studying the sky not only or not entirely for its utilitarian aspects. A good part of the study was motivated by his curiosity. The seemingly erratic behaviour of the planets, vis-a-vis the orderly motion of the stars, was intriguing man. Using the data scrupulously collected by himself and his predecessors — Tycho, in particular — Kepler formulated in the early 17th century his three famous laws governing planetary behaviour. That gave the kinematics or the geometry of planetary movements. Looking for the kinetics or the causal aspects of such movements, man could arrive at his new mechanics. He learnt why the apple falls to the ground and why the Moon goes round the Earth; he clearly understood what sets something into motion and how, and wherethrough to prevent it. And the impact of this knowledge was unprecedented, unbelievable — almost unimaginable, to the earlier generations of mankind.

RECENT TIMES

To classical mechanics, enunciated by Newton and such other stalwarts, man's continuing indebtedness even today beggars description. But this mechanics is not his only mechanics. Man has found it necessary to modify and refine it, for use in some special areas. This mechanics, that may be referred to as relativistic mechanics, man has learnt principally by studying the behaviour of light, and at least some of the primary and crucial findings in this regard man procured while studying the sky. For example, the great astronomer Roemer made the very difficult and significant discovery about light having a finite speed by systematically observing and timing the eclipses of the satellites of Jupiter.

Currently, history has been witnessing phenomenal progress of man — on the material plane — principally because of his success in unravelling the microworld, i.e. the world of subatomic particles. Now one major key to unlock the mystery of these fundamental particles has been provided by spectroscopy, and spectroscopy owes its origin to the sky. Newton initiated the study of spectra and what he had studied was the solar spectrum. In the early 19th century Wollaston first noticed that some dark lines were invariably present in the solar spectrum; about a decade later Fraunhofer marked their precise positions and after about half a century Kirchhoff announced his three laws accounting for their presence. And that is how the science of spectroscopy came into being — the science that has of late given man an insight into the ultramicroscopic world of electrons, protons etc., a world of unlimited potentialities for him to tap.

CONCLUSION

A careful scrutiny of the history of man, reading it between the lines, reveals that, at all important junctures so far, as man has been marching forward, heaven's light has been his guide, so to say.

REFERENCES


PUTTING OVER COSMOLOGY IN THE
PLANETARIUM

Anthony P. Fairall

ABSTRACT
All-sky projections, working either in register with the star projector or on their own, are essential for teaching modern astronomy. Approaches for teaching about galaxies and cosmology are discussed.

INTRODUCTION
As both a professional astronomer and a planetarium director, I am particularly keen to use the planetarium to present modern research developments. Yet the standard planetarium projector is designed to show only the night sky as it appears to the naked eye. Almost all traditional planetarium presentations are based around the naked eye view, and there is nothing wrong with that - except there is so much more to modern astronomy.

One could, of course, resort to slides, but a small rectangular frame never has the impact of a hemispherical projection. Rather, one must seek ways to create scenes that are visually spectacular, but carry a very important teaching aspect at the same time. An obvious example would be to exchange the naked-eye sky for a radio sky, or an infra-red sky: yet material, or devices for doing this, do not seem to be commercially available.

My own particular interest concerns the universe on the largest scale possible, since this is my field of research. Each year I go on a number of observing runs to obtain the redshifts of galaxies. I am also involved in preparing catalogues of redshifts, and attend international conferences on large-scale structures and cosmology (Prior to the IPS, there is a supercluster workshop in Italy, while the 25th anniversary of the discovery of the Cosmic Microwave Background will be commemorated at a conference in France next month). It may seem selfish to want to promote one’s own research speciality in a planetarium, but the universe as a whole is just as important as a naked-eye view of the sky. If the diagrams that accompany this article convey something you are not already aware of, then you, like many members of our audiences, need more exposure to modern cosmology!
FIGURE 1. Neighbouring superclusters and large-scale structures within approximately 300 million light years of our galaxy (schematic diagram). Foreground material within our galaxy obscures part of the view.

FIGURE 2. As we look deeper into space, so we look back in time. The limit is the early opaque incandescent universe, now visible in microwaves.

I have the privilege of being director (part-time) of a sophisticated new planetarium. Our facility in Cape Town boasts a Minolta MS-15 star projector under a 15 metre dome. The auditorium is completely surrounded by a circular projection gallery which presently carries over 30 slide projectors, including a 12-projector panorama and a 6-projector all-sky arrangement. Visual effects are complemented by a high-quality sound system, based on 8-track tape.
ALL-SKY PROJECTIONS

It is the all-sky system (Villard and Zirpoli 1983) that offers the best avenue for alternative scenes to the star projector, though in some cases the all-sky-projectors can work together with the star projector to create a combined scene of the sky. For instance, one cannot easily teach cosmology without the audience clearly understanding the nature of our galaxy and other galaxies. Yet a naked-eye view of the sky does not show our galaxy very clearly. The structure of the galaxy could be better seen and appreciated if our eyes were more sensitive, and, in a planetarium, they can be made more sensitive. We have used our all-sky projectors, in register with the star projector, to enhance the Milky Way and to stress the masses of stars in the central bulge of our galaxy. Colourful red nebulae are also brought out. The Magellanic Clouds are enhanced, and many other surrounding galaxies are apparent. The scene not only conveys our standing within our galaxy, but also the relation to various neighbouring groups of galaxies. The star projector is set for the South Pole; thus only one of its star globes is required and the machine can be lowered just below dome level, so as to be clear of the all-sky projections. (This combination of all-sky and star projectors in register offers other possibilities. We use it for all-sky constellation figures, and we are working on dissolves to a radio sky, etc.)

Just as the star projector can cover the dome with stars, so an alternative scene with the all-sky projectors can cover the dome with galaxies. Galaxies are not pinpoint objects, so it is not really a problem that the images from the all-skies are not equally as crisp. In any case, individual foreground galaxies can be superimposed with the regular projectors. If necessary, a foreground galaxy can rotate or drift slowly against the all-sky background.

The all-sky projectors are also ideal for showing cosmic evolution. For a recent production, we used them to follow the big-bang beginning (explosion, camera flashes) with a hot early incandescent universe (flickering and rumble) which gave way to a cooler transparent universe (tranquil and quiet). We then saw how large-scale structures became apparent, and were followed by galaxy formation - all this with sequential all-sky projections.

The most incredible aspect of modern cosmology is that we can actually see back to this early universe. We can even use it to measure the speed our own galaxy is moving in space. But it requires “seeing” in microwaves - and the only place where that is possible is inside a planetarium!

REFERENCE


THEATER IN THE PLANETARIUM

Mariana Back

Kosmorama Space Theater is a small planetarium in a mid-sized city in Sweden. We have been running the planetarium at the Futures’ Museum since 1986. The activity has been based on live presentations of “The Northern Sky Tonight”. A couple of shows, using slide projectors and some special effects, have been shown as well.

The programs have been based on astronomy education and has mainly been dedicated to youths in school. 1989 we decided to produce a planetarium/theater show for schools and for public in general.

ANIARA- A JOURNEY IN WORDS, MUSIC AND IMAGES.

Aniara is a presentation in the planetarium based on the work of Harry Martinson. Harry Martinson is without doubt one of Sweden’s greatest modern writers, celebrated for his prose, poetry and novels, all of them full of life’s wisdom.

The storyteller in Aniara says: “Through war and other sources of environmental pollution, the planet Earth has become poisoned. Its men and women are forced to evacuate the planet in enormous space ships. One of these ships, called Aniara, collides with interplanetary material and is forced off its set course for Mars. Aniara veers away from the solar system.”

A story must have a happy ending, Martinson thought. But what about Aniara? Aniara is a symbol for our own spaceship Earth. It was written 1956, in despair over a uncontrolled technocratic expansion. We can now look at Aniara’s vision of the future through a rear-view mirror.

The threats are still many, but we can also see our Earth from a new perspective, as the Living Planet. A world worth caring for. Pictures taken of Earth from space have given us a sense of humility for our home in Universe.

As a visitor in the planetarium you are an actor in the show. You are one of the passengers aboard the spaceship. On the journey you meet the crew, the chief astronomer and other people aboard.
COSMIC CATASTROPHES AND PLANETARIUM OPPORTUNITY

Jeanne E. Bishop

ABSTRACT

Space catastrophes have become a recent popular topic. Not well known to the general public are estimations of risk for devastating cosmic collision in our time. This paper highlights the evidence and risk and then focuses on suggestions for communicating a balanced menu of information, recommendations, and the process of theory evolution to different types of audiences.

Since Luis and Walter Alvarez published their famous paper in 1980, most geologists, biologists, and even astronomers had not given serious thought to an asteroid or comet nucleus striking earth and causing mass extinctions. At first there was widespread debate on whether the material found at the K-T layer representing 65 million years ago was the result of impact or volcanic origin. Now the increasing evidence—shocked grains of quartz and calcite and high-pressure-forming minerals of coesite, suevite and lechatelierite—has made most scientists accept the impact theory. Further, 5-10-km objects very well may have caused periodic extinctions throughout the geologic past. (Weissman, 1990).

On March 23, 1989, asteroid 1989PC missed hitting the Earth by only 690,000 km and was discovered only after its near-miss. (Sinnott, 1989). If a collision had occurred, a crater about 10 km wide and 1.5 km deep would have been created on land. A sea, enormous tidal waves would have occurred. The energy of 20,000 one-megaton H-bombs would have been transferred. In comparison, the projectile that produced the Barringer Meteor Crater in Northern Arizona in the U.S. had the kinetic energy of just 15 megatons. And this hit was enough mass to displace a trillion tons of rock and blast a billion tons of fine dust into the atmosphere (Chapman and Morrison, 1989).

Evidence abounds that our solar system is a dynamic and perhaps dangerous place.—Voyager spacecraft data of moons that are amalgamations of previously-existing bodies; our own moon and others peppered with craters, not all of ancient origin; ancient craters and asteroids around the world, the abundance of Earth-crossing asteroids, and Chaos-theory revelations about lack of constancy of solar-system bodies in their orbits (Hartley, 1990). The Capture Theory of the origin of the solar system embodies ideas which implicate a very dynamic solar system (Dormand and Woolfson, 1989) and planet ring evolution theory does the same. (Aviation Week and Space Technology, 1990).

In June, 1980, the U.S. NASA sponsored a symposium on new directions for space efforts. A subgroup considered the threat due to asteroid impact. Their recommendations were to construct special equipment to search for potential impactors, and if any are found, prepare a spacecraft with a bomb to nudge the object away from a collision course. The prospects and action are amazingly similar to the science fiction book and film by Edward North and Franklin Coen (1979), Meteor. The group report gave carefully-calculated probabilities of risk of death by impact compared with risk of death from other sources: a) 1/60 the chance of death in a car accident, b) 1/30 the chance of death by murder, c) 10 times the chance of death in a tornado, d) 100 times the chance of death from fireworks, and e) 300 times the chance of death from botulism poisoning. The report, which could have created much public fear via sensational media descriptions, was never released. (Chapman and Morrison, 1989).

Of course the estimates of the NASA study group need to be refined. Planetologists Clark Chapman and David Morrison (1989) argue that use of just 1 percent of the U.S. NASA annual budget to mount a careful search for potential impactors is a prudent course of action.

As planetarium communicators, we are in an ideal position to convey ideas of cosmic catastrophes (impact, harm from a relatively close supernova, atmospheric warming) and expert recommendations about them. We are also in an excellent situation to transmit correct ideas about the evolution of theories and the not-always-straight-forward workings of science. I think we should present balanced presentations of cosmic catastrophe topics, but we need to handle them carefully. People are most afraid of what they have the least control over. Fear is easily invoked in some due to a perceptual magnification of the risk.

I have recommendations for different types of planetarium audiences with which I am familiar. The characteristics of each group indicate the use of certain procedures and the refrain of use of others.
First, consider the public program audience. Typically it includes many young adults with children from age 5 to 10. Parents learn with their children and interpret for them, especially the youngest. Attendance is motivated by a combination of recreation and education. I recommend the use of sophisticated terms that only the adults will comprehend when mentioning upsetting risk data. Do not scare young children who are not old enough to differentiate certainty and probability from a very small possibility. In order that adults will comprehend the true nature of the situation, develop the changing status of the theory of mass extinctions due to impacts. Discuss the fallibility of predictions and assumptions on which they are based. Quote different experts with divergent views based on the same evidence. Proceed slowly and interestingly through graphs and other mathematical descriptions, restricting the total use of mathematics to a couple well-explained items.

As one example of a student audience, consider age 13, the budding teenager. For this group there are overwhelming effects of physical maturation on thinking. Peer pressure is strong. Many of this group are very talkative with peers and adults in a non-threatening situation. Abstract reasoning is developing. Most would like to work together on projects to help the world, and organized projects are met with high enthusiasm and energy.

For the young teenager, I recommend group (large and small) discussions following information presentations. A multi-media presentation in the planetarium, a lecture, or assigned reading should always precede opinion-forming discussions, so that students do not prematurely offer ideas that are in conflict with facts. Understanding of theory, science, and mathematics is probably better than that of many adults, but unlike adults, the students do not typically discriminate priorities in the importance of different relevant criteria. Guidance is essential. A culminating practical effort, such as writing letters with their suggestions to politicians, can make this a meaningful topic for life.

Senior citizens represent a large, growing segment of many countries' populations. Many of our older citizens have weak science and math understanding, but some have high interest in science. Experience from solving life problems makes most quite practical. Due to inflation during their lives, large sums of money appear larger to them than to young adults. I recommend the presentation of a catastrophe idea to this group as a unit which includes all related science.—Don't assume any science understanding prior to the presentation, such as the true scale of distance between planets, the definition of "Asteroid" and "comet", and how to read a graph. This group will not scare easily, and they may be difficult to convince that there is much problem at all. Hold a discussion following a presentation and show that the viewpoints of these people are valued. The discussion, rather than the time of presentation, is apt to be the time when these people will come to understand and attach value to the situation.

Time does not permit me to share observations of other types of groups we meet in the planetarium. However, I urge you to consider the nature of any group to which you present this topic. Only by fitting presentation to audience characteristics will a perspective be reached that will be helpful to society.


ROBOTS IN SPACE FEATURING R2D2 AND C-3PO

William A. Gutsch

ABSTRACT

In cooperation with Lucasfilm, Ltd., the American Museum-Hayden Planetarium has recently completed production on "Robots in Space featuring R2D2 and C-3PO." Utilizing video laser discs plus conventional planetarium projections, the program is presented live but allows for teacher/projection interaction and individual audience pacing.

TEXT

At the American Museum-Hayden Planetarium in New York, work has been completed on "Robots in Space," a planetarium program created in cooperation with Lucasfilm, Ltd., and featuring R2D2™ & © and C-3PO™ & © from the Star Wars Trilogy. The program is intended to teach children ages 7 through 12 how scientists use satellites and space probes (space robots) to learn about the universe, with topics ranging from the earth and our neighbor planets to nebulae, star clusters, and black holes.

Following the successful formula used in an earlier Hayden creation, "Wonderful Sky with the Sesame Street Muppets," the intention with "Robots in Space" was to again produce a program which would be given live by a planetarium staff member but would allow that live presenter and the planetarium audience to interact with pre-recorded projections of famous characters on the dome. The story concept and script were developed by myself, and, from the beginning, Terence Murtagh was asked to serve as advisor and technical director on the project because of his extensive experience in video applications to planetariums.

All scenes for "Robots in Space" involving R2D2 and C-3PO were shot on videotape on a soundstage designed to our special requirements at Industrial Light and Magic in San Rafael, California. The remote-controlled R2D2 seen in "The Empire Strikes Back" and "Return of the Jedi" was used, and Tony Daniels flew over from England to recreate his famous character, C-3PO.

Voiceover dubbing by Mr. Daniels and video special effects post production then continued in London. After further voice overdubbing for R2D2, music and sound effects were added by Jonn Serrie in his Connecticut studio, and all audio channels were mixed and mated to the master videotapes.

Finally, the master videotapes (which contain all robot images and some special effects against video black plus all music, voice, and sound effects) were converted into a set of two, 12-inch, optical laser discs at Pioneer Communications in California.

When presented in the Sky Theater, the formatless optical laser disc images are combined with standard incandescent planetarium effects and panoramas to create composite scenes. The entire program is then controlled via AVL and Sky-Skan computers wired to a single button. This button is hidden but attached to a hand microphone used by the live presenter. Using the visually clean stop action capability of laser disc projection and carefully planned programming, the presenter is then able to control the pace and response timings of the program from audience to audience. This allows individual audiences to verbally interact with R2D2 and C-3PO at their own rate with no one "stepping on" each other's lines.

"Robots in Space" premiered at the American Museum-Hayden Planetarium in the spring of 1990 and is being made available to other planetariums. A more detailed article on production methods used in what we believe represents a new and exciting use of video in planetarium theaters will be prepared for a future issue of The Planetarian.

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© Muppets, Inc., Children's Television Workshop
COM FLY WITH US - A SPACE PROGRAM

Peter F. Connors

COM FLY WITH US - A SPACE PROGRAM is a spinoff of S.T.E.P. (Space Technology Environmental Program) at Half Hollow Hills Schools in New York. S.T.E.P. began in the Spring of 1986 with the building of a U.S. Space Shuttle replica that measured 10 feet wide and 40 feet long. S.T.E.P. is an interdisciplinary program that allows the assimilation of many curricula in levels from primary to secondary. It can be applied to science, mathematics, computers, ecology, social studies and linguistics. Each program encourages cooperative learning techniques. Students must rely upon each other if the program is going to reach a successful conclusion.

During the past years S.T.E.P. has continued to grow in scope and facilities. We are now providing extensive hands on interactive science programing for all of our elementary students. The highlight of the program has been the training of 15-17 students to fly a three hour simulated space flight which features a full mission control, cockpit, science bay, lunar lander and extravehicular activities.

We have been repeatedly asked if we could develop a simulator and programs that could encompass an entire class of students. COM FLY WITH US will attempt to supply you with the ideas and concepts that have been developed in our program at Half Hollow Hills Schools.

The first step in developing a space flight program is to put together a control panel simulator that will be adaptable to any age group. In books such as The Space Shuttle Operations Manual or The Enterprise Above and Beyond you can find examples of consoles. We developed a control panel that in many ways is a replica of the consoles found in the US Space Shuttle. Our consoles have been constructed using the Auto CAD computer program and can be scaled to any desired size. The consoles can be scaled from desk size to actual flight configuration. The panels can be mounted on any ridged surface or sandwiched between two thin layers of plastic. To add more realism toggle switches can be mounted in the unit simply by drilling a hole, of the appropriate size, and securing the toggles. Toggle switches can be purchased in quantity from electronic wholesalers. One good source of extremely inexpensive toggles switches is from an electronic junk yard or surplus electronic house. In addition, small LED's have been placed above each toggle or series of toggles in the cockpit. These lamps blink when activated from mission control. This allows students to find the appropriate switches without memorizing the entire console.

At S.T.E.P. we focused on developing a crew of twenty-eight students who all fly our shuttle for a fifty minute spaceflight. They are divided into a mission control team and a flight team. After the initial flight the two teams trade tasks and continue with an additional fifty minute flight.

The following are the positions held by these students:


The flight is organized into a series of task activities to be completed by each team of students. The timing of the tasks is accomplished by a mission clock. As each task is completed the time of completion is logged on a computer or flow chart that represents the flight profile.

An illustration of some job responsibilities and tasks is as follows:

COMMUNICATIONS - all communication between ground and flight teams MUST pass through the communicators who use a wireless headset.

WEATHER - to prepare weather profiles for launch and landing, using National Geographic Weather Data.

E.V.A. CAMERA PERSON - uses a video camera to record the E.V.A. tasks.

VIDEO EFFECTS (A.V.) - students will change video effects seen in the cockpit by using slides and short segments of video tapes to illustrate parts of the flight, such as docking, E.V.A., launch, landing, etc.

PUBLIC AFFAIRS OFFICER - provides an oral commentary on all aspects of the flight - this may be recorded.

LUNAR TEAM - lands on the moon, completes robotic tasks by using a video camera and display.

E.V.A. TASKS - students seated in wheel chairs perform E.V.A. to build a space station truss assembly.

This assembly is made of PVC pipe or Unistrut Corporation.
SCIENCE TEAM - students perform experimental tasks such as: blood pressure, hand-eye coordination, reaction control, reflex action, crystal growth, acid rain, and space telescope. Each experimental task requires the gathering and recording of information. The Mission Control Science Team analyzes and graphs the data collected in space.

This is a very brief description of a space flight simulator and program that you can develop. More extensive descriptions are obtainable upon request. Other sources for flight programs are obtainable from The Space Shuttle Operators Manual and The Enterprise and Beyond.

REFERENCES:
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"Observatory Light Speed Software", Berkeley, California 94704, USA.
"Bio Feedback Software", HRM Software, 562 Boston Avenue, Bridgeport, Connecticut 06610, USA.
"Body Electric", HRM Software, 562 Boston Avenue, Bridgeport, Connecticut 06610, USA.
INTEGRATED PLANETARIUM AND CLASSROOM ACTIVITIES FOR SCHOOLS

Alan Gould

ABSTRACT

It is not common for most planetariums that have visiting school groups to provide extensive classroom activities related to the planetarium programs for teachers to do back in the classrooms. We have found that classroom activities related to a planetarium program can greatly enhance the planetarium experience for the students.

Most times when a school group has visited our planetarium, we have not supplied any materials to the teacher for use in preparation for the planetarium visit. We have usually handed out some item of interest during our hands-on style planetarium programs, but we haven't supplied any significant post-visit classroom activities related to the planetarium program. Many teachers are not concerned about the fact that their planetarium visit is virtually unrelated to their classroom work. The field trip is almost a "day off" and can be written down as satisfying some sort of science requirement that their class is fulfilling. However, many teachers, if afforded the opportunity, would jump at the chance to make their planetarium visit a part of an integrated astronomy science curriculum in which they could involve their students in classroom activities leading up to the field trip as well as related activities for after the planetarium visit.

To this end, the Lawrence Hall of Science (LHS) at University of California, Berkeley, and the New York Hall of Science (NYHS) at Corona, New York, are conducting Summer Institutes in Astronomy and Space Science for elementary and middle school planetarium educators from throughout the United States. These Institutes are designed to help school districts develop astronomy curricula based on planetarium and classroom activities that allow students to become actively involved in doing science in both environments. The Institute participants are selected based on their experience both in teaching science and their ability to present teacher education workshops for their school districts after attending our Institute. Each Institute is three weeks long. Two Institutes took place in the summer of 1989 and two more are occurring this summer (1990).

Participants in the Institutes receive a wealth of curriculum ideas and materials, including (1) a series of eight volumes, developed specifically for these Institutes, entitled Planetarium Activities for Student Success (PASS), (2) a set of seven teacher guides for astronomy and space science activities from the LHS publication series, Great Explorations in Math and Science (GEMS), (3) packets of resource materials including brochures, catalogs, and magazines, etc., (4) a teaching guide for the Elementary Science Study (ESS) activities, Daytime Astronomy, (5) teaching guides for Project Starwalk, and (6) Sky Challenger star wheel sky observing activities.

At each Institute, participants:

• use portable planetaria (one of which was generously donated by Learning Technologies of Cambridge, Massachusetts) for participatory planetarium shows that could also be presented in permanent planetarium facilities,
• learn to use the activity-based astronomy and space science curricula: Project Starwalk, Daytime Astronomy (ESS), GEMS, PASS, and Sky Challenger,
• share curriculum ideas with other participants from around the country,
• attend presentations by a professional astronomer to enrich background knowledge and introduce current topics of research in astronomy,
• observe celestial objects at an evening stargazing session and learn how to use telescopes and organize such events,
• visit a few major planetariums and observatories in the San Francisco bay area.

The institutes are supported by grants from Learning Technologies, Inc. and the (US) National Science Foundation. Transportation, room and board, and stipends are provided for all participants.

Of interest to IPS members is the availability of the GEMS curricula (from Lawrence Hall of Science) and the eight volume PASS Series described below.

**Planetarium Activities for Student Success**

Series Editors: Cary Sneider, Alan Friedman, and Alan Gould

This series of eight books is designed for both experienced planetarium instructors and teachers who will be using a planetarium for the first time. It provides an abundance of practical ideas for creating entertaining and educationally effective programs for students. Volumes 1 through 4 in the series provide an orientation to student participatory astronomy and space science education. The remaining volumes each present a complete planetarium program and related classroom activities. The materials are intended to be useful in your day-to-day work with students and teachers, as well as springboards for your imagination and creativity.

**Volume 1: Planetarium Educator's Workshop Guide** - Participatory planetarium programs involve students actively in the planetarium environment resulting in programs that are both entertaining and educational. This guide introduces the theory and practice of developing effective planetarium programs through a series of thought-provoking activities and discussions. This volume is also very useful in designing workouts for teachers focusing on how to conduct participatory planetarium programs and/or classroom activities in astronomy and space science. This volume is a revision of the IPS publication, Special Report No. 10 of 1980.

**Volume 2: Planetarium Activities for Schools** - This second volume in the PASS series, by Gerald Mallon, provides a wealth of examples of effective planetarium activities for elementary and middle school students, as well as ideas for developing new activities for students of any age.

**Volume 3: Resources for Teaching Astronomy & Space Science** - This annotated resource guide pulls together the best resources that we have been able to find for teaching astronomy and space science at the elementary and middle school levels. Includes chapters on curricula, books, periodicals, films, videos, slides, organizations, portable planetariums, telescopes, and other resources.

**Volume 4: A Manual for Using Portable Planetariums** - Primarily a "how-to" manual for setting up and using the Starlab portable planetarium, this guide has many suggestions for setting up and using any planetarium to teach school programs.

**Volume 5: Constellations Tonight** - In this participatory version of a classic planetarium program on the night sky, students receive star maps and have an opportunity to use them to find constellations in the planetarium sky. Classroom activities which accompany the planetarium program include mythology, pattern recognition, creating constellations, map reading, and making starclocks. Revised from the appendix to 1980 IPS Special Report 10.

**Volume 6: Red Planet Mars** - Students discover Mars three ways during this program: they find Mars by observing it for a few weeks as it moves against the background stars; they view it through a telescope and map its surface; and they see Mars through twentieth century space probes. Classroom activities: how to recognize a planet, modeling the solar system, and exploring possibilities for extraterrestrial life. Revised appendix to 1980 IPS Special Report 10.

**Volume 7: Moons of the Solar System** - Program includes observations of Earth's Moon and a modeling activity to explain phases and eclipses. Students track Jupiter's satellites and journey through the Solar System to see dozens of other satellites. Classroom activities: reasoning motions of the moon in the daytime sky, performing experiments in crater formation, using moon maps, & designing moon settlements.

**Volume 8: Colors and Space** - What can we learn about the stars and planets from their colors? Students deepen their understanding of why we see color as they take an imaginary trip to a planet circling a red sun, and experiment with color filters and diffraction gratings. Classroom activities include making secret messages that can only be decoded with color filters, using color filters to view nebulae and planets, mixing colors, and making spectrosopes.

**Great Explorations in Math and Science (GEMS)**

**Teachers' Guides for Classroom Activities**

**Color Analyzers** by Cheryll Hawthorne and Cary Sneider  Grades 5—8
Price: $10.00  76 pages  Subject Areas: Physical sciences (light, color, color filters, diffraction gratings)

The students investigate light and color while experimenting with diffraction gratings and color filters. They use color filters to decipher secret messages, then create their own secret messages. A classroom set of red and green filters and diffraction gratings is included. Skills developed include observing, comparing, classifying, inferring, predicting, recording data, and drawing conclusions. Time: Four class sessions.

**Earth, Moon, and Stars** by Cary L. Sneider  Grades 5—8  Price: $9.00  50 pages  Subject Areas: Astronomy (history of astronomy, spherical earth, gravity, moon phases, eclipses, measuring time, earth's daily motion, the North Star, constellations, horizon, zenith)

Six activities reveal information on fascinating astronomical subjects, including ancient models of the universe, gravity, the phases of the moon, constellations, and telling time by the stars. Activities help students answer questions like: If the earth is round, why does it look flat? Why does the moon change its shape? Students observe and record changes in the sky and create models to explain observations. Skills developed include: creating/using models, synthesizing, visualizing, observing, explaining, measuring angles, recording, estimating, averaging, using instruments, drawing conclusions, using a map. Time: Six 40- to 45-minute sessions, four 20- to 30-minute sessions, six 15-minute sessions.
Experimenting with Model Rockets  by Cary Sneider  Grades 6—10  Price: $11.00  100 pages  Subject Areas: Rocketry, technology, triangulation, controlled experiments

The process of controlled experimentation is introduced in this exciting series of rocketry activities. The students experiment to see what factors influence how high a model rocket will fly by varying the number and placement of fins or the length of the body tube. Safety considerations and teamwork are stressed. Students use Height-O-Meters to measure the height of the rockets, so it is necessary to present that activity guide (see next entry) before conducting the rocketry activities. Skills developed include planning and conducting controlled experiments, measuring in degrees and meters, graphing, and interpreting data. Time: Seven class sessions.

Height-O-Meters  by Cary Sneider  Grades 6—10  Price: $ 6.50

60 pages  Subject Areas: Angular and Linear Measurement, Triangulation with Scale Drawings, Calibration

The students are introduced to the principle of triangulation by making simple cardboard devices named Height-O-Meters. Students measure angles to determine the height of the school flagpole, and compare how high a styrofoam and rubber ball can be thrown. Skills developed include predicting, estimating, making and calibrating scientific instruments, measuring in degrees, graphing, calculating, interpreting data. “Going Further” activities relate triangulation to the real-life activities of forest rangers and astronomers. Completion of this unit is required prior to presenting GEMS rocketry activities. Time: Four class sessions.

Hot Water & Warm Homes from Sunlight  by Alan Gould  Grades 4—8  Price: $7.50  40 pages  Subject Areas: Solar Energy and Heating, Greenhouse Effect, Home Energy Use, Conducting Controlled Scientific Experiments

The students conduct experiments with model houses and water heating to discover more about solar power. They learn what a controlled experiment is, and conduct experiments to determine the effects of size, color, number of windows, and other variables on the amount of heat produced by sunlight. Skills developed include: experimenting, controlling variables, measuring and recording data, graphing, drawing conclusions. Time: Five or six 20- to 45-minute sessions. Introductory activity on controlled experimentation (if needed): 20-30 minutes.

More Than Magnifiers  by Cary I. Sneider  Grades 6—9  Price: $ 6.50

48 pages  Subject Areas: Lenses, Images, Focal Length, Magnifiers, Cameras, Telescopes, Projectors, Field of View

In a series of four activities, using the same two lenses, the students find out how lenses are used in magnifiers, simple cameras, telescopes, and slide projectors. The students learn that lenses have certain properties that can be measured, and that these properties help determine which lenses are best for specific purposes. Skills developed include: observing, comparing, measuring, graphing. Time: Four 30- to 50-minute sessions.


The students investigate and analyze the properties of a strange green substance named “Oobleck,” said to come from outer space. The class holds a scientific convention to critically discuss experimental findings. Students design a spacecraft that would be able to land on an ocean of “Oobleck.” Skills developed include: experimenting, recording data, engineering, communicating, group brainstorming, and decision making. Time: Five or six 20- to 45-minute sessions.

The Wizard’s Lab  by Cary I. Sneider and Alan Gould  Exhibit Guide for museum science educators and exhibit builders, and school discovery labs. Grade level: all ages to adult

Price: $49.50  72 pages  Subject Areas: Physical Sciences (Pendulum Swing Rate, Resonance, Oscillating Motion, Superposition of Motion, Speed of Rotation, Angular Momentum, Magnetic Poles, Batteries, Generators, Electrodes, Electrolyte, Solar Cells, Series/Parallel Circuits. Lens Focal Length, Images, Polarization of Light, Sound, Superposition of Waves)

This exhibit package contains ten of the most popular interactive exhibits in the LHS Wizard’s Lab, providing a wide spectrum of stimulating activities in the physical sciences. Exhibits include: the spin platform, solar cells and light polarizers, resistant pendula, magnets, lenses, the “human battery,” the oscilloscope and sound, the harmonograph. Exhibits are easy to construct, utilize common materials and equipment, and can be used in science centers and school discovery labs. Background information on cards with cartoon wizard figures briefly explains principles behind each exhibit. Skills developed include: observing, analyzing, finding patterns.
THE LEO MYSTERY HOUR
Sheldon Schafer

ABSTRACT
A Mystery Format can provide a strong motivation for elementary students visiting the planetarium.

With the help of Sherlock "Domes" students use a "Big Dipper Clock" to construct a "Leo Clock." The clocks provide the critical clues to catch the culprit and clinch the case. Third grade students use their observational skills and deductive reasoning to determine the time of the crime and prove that the suspect lied about his alibi. This paper will discuss the key elements of this participatory lesson.

INTRODUCTION
At the Lakeview Museum planetarium we have a repertory of numerous multi-media planetarium shows, of which several are now enhanced with our new Sky Skan video laser disk projection system. In addition to these selections, we also have an even more extensive library of participatory lessons focusing on some of the basic but essential topics in astronomy which are most effectively taught with the standard planetarium. One of the most developed of these is Project Starwalk. (Olmstead, 1984; Riddle, 1990; Schafer, 1986) Originally developed by Pat Olmstead of the Colonial School District in the state of Delaware, Lakeview Museum became its headquarters in 1986. [Project Director, Robert Riddle, has just moved to the new planetarium facility at Kansas City's Southwest Magnet School; further inquiries on Starwalk can be directed to him there.] This curriculum develops an understanding of the topics of rotation and revolution, time, and the calendar.

In maintaining our commitment to presenting "hands-on" astronomy in the museum environment, we constantly seek to enhance these experiences with motivational "tricks." One of the more popular of these teaching strategies has been to introduce a "mystery" to be solved. Even students as young as 3rd grade, the level for which this lesson is intended, are intrigued by sinister circumstances and the possibility of solving a mystery.

The students first begin to suspect that something is amiss as they approach the planetarium. A trail of footprints leads up to the door and into the chamber. At the end of the trail lies a pair of boots and a cape, dropped on the floor.

After seating and organizing their worksheets, the class members learn that something mysterious has been going on. SULUNA, (named after the sun and moon face), the planetarium's extraterrestrial mascot, has mysteriously disappeared. The students also learn that they are going to be the star detectives, using their observational skills and powers of deduction to help solve the crime. The "time" of the crime is always an important element in solving any case, and each student just happens to have brought a "Big Dipper" clock made prior to their planetarium visit.

After this introduction, the students are then instructed in how to use their "Big Dipper Clocks." We first determine that these clocks are a map of the northern sky, with west to the left and east to the right, with the zenith at the top, and south not shown.

The students then practice setting the clock for different times of the day or night, and determining where the Big Dipper would be located in the sky, using two criteria: 1) it is high, low, or half-way up in the sky and 2) is it NE, NW, or directly north. The clocks are then set at 8 p.m. (for a March visit, 10 p.m. for April visits) and using these criteria, the students are asked to stand and point to where the Big Dipper should be on the fully lighted dome. One student is given the arrow and asked to point with it so that all can see, and the dome is darkened. They gasp audibly as they discover that their predictions were correct, when the stars of the Big Dipper almost miraculously appear where the arrow is pointing.

The students then sit down and locate Leo in the sky. After its position is described verbally, using the same direction and attitude criteria as for the Big Dipper, they then record it on their "Leo Clock" worksheet.
Upon completing these steps, the Big Dipper clock is set for Midnight (or 4 hours later), its position described, and the students then observe the sky, noting the apparent motions of the stars, and the ultimate position of the Dipper at Midnight. Leo is then located, its position again described and then recorded on the "Leo Clock" worksheet.

With these preliminaries, it's now time to introduce the mystery. With trumpet fanfare (recorded) our master detective is called into the theater. (If one of our more suspicious looking staff members is also available, he is brought in as the suspect) Our master detective introduces himself as "Sherlock Domes" [In English, the name is a comical play on words]

The dialogue for the remainder of the lesson continues thus:

Sherlock: There was a kidnapping, or perhaps it would better be called an "alien knapping." The suspect claimed that he was innocent. At the time the crime occurred, he claimed that he was coming out of the grocery store at the shopping center. He remembered the evening well, because he recalled seeing "Leo" here (point to position in the East on the projection of the "Leo Clock" worksheet) in the sky as he carried his groceries to the car.

Why do we need to know if the suspect is telling the truth?

[Student response] We need to know what time was it when he claimed to have seen Leo here [point] in the sky.

Sherlock: Remember, we can use the stars at night to tell time, just as we use the sun during the day, because the Earth is rotating at the same speed all the time, day and night.

We give the student a clue: How many hours passed from when Leo was here (point at overhead projector transparency) to when Leo was there (point)?

Tell me what the answer to the clue is, and how you used the clue to determine the time that the suspect claimed he saw LEO.

[Student response] 4 p.m.

Sherlock: Was the suspect lying?

[Student response] Yes.

How do you know? Remember that your reasoning has to be convincing to the jury, or the suspect will go free. You can't convict a person based on just a lucky guess.

[Student response] He was lying because it was still daylight, and so LEO wasn't visible.

Sherlock: So, if it was daytime, what could we use to tell the time if we can't see LEO?


Sherlock: For the final piece of evidence to convict the suspect, we have to use the sun to prove that Leo was [here] in the daytime ....... (set the sun for the chosen time and dim the lights to locate LEO.)

Was LEO really there in the daytime just as we predicted.

[Student response] Yes!

Sherlock: Then the suspect was lying about seeing LEO!

Guilty!

Case closed!

In summary, a mystery format can be an effective tool in a planetarium lesson for stimulating a student's interest, and thus his observational and reasoning powers.
REFERENCES


ASTRONOMY EDUCATION IN SMALL PLANETARIUMS

Erling Husby and Björn Stenholm

Leaders: Erling Husby, Tromsø, Norway (chairman)
Björn Stenholm, Lund, Sweden (secretary)

The other participants were:

<table>
<thead>
<tr>
<th>Name</th>
<th>City/Country</th>
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<tbody>
<tr>
<td>Kenneth Adams</td>
<td>Redding, CA</td>
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<tr>
<td>Pelle Eckerman</td>
<td>Stockholm</td>
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<tr>
<td>Bertil Eriksson</td>
<td>Borlänge</td>
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<tr>
<td>Elisabeth Fagerstedt</td>
<td>Stockholm</td>
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<tr>
<td>William Farwell</td>
<td>South Shields</td>
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<tr>
<td>Donna Favour</td>
<td>Dallas, TX</td>
</tr>
<tr>
<td>Roy A. Gallant</td>
<td>Portland, ME</td>
</tr>
<tr>
<td>Martin George</td>
<td>Launceston</td>
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<tr>
<td>Eva Maria Hans</td>
<td>South Shields</td>
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<tr>
<td>Shoichih Itoh</td>
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<td>Arvo Kuusela</td>
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<td>Sakari Lehtinen</td>
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<tr>
<td>Elisabeth Lindberg</td>
<td>Luleå</td>
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<tr>
<td>Gunilla Mattsson</td>
<td>Göteborg</td>
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<tr>
<td>Ludwig Meier</td>
<td>Jena</td>
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<td>Kenneth Perkins</td>
<td>St. Petersburg, FL</td>
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<tr>
<td>Louis Ramponi</td>
<td>Brescia</td>
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<tr>
<td>Robert Reilly</td>
<td>Williamsville, NY</td>
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<tr>
<td>Robert Risch</td>
<td>Lakewood, CO</td>
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<tr>
<td>Markku Sarimaa</td>
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<td>Eric Schreur</td>
<td>Kalamazoo, MI</td>
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<tr>
<td>Daniel Smith</td>
<td>South Bend, IN</td>
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<tr>
<td>Richard Speir</td>
<td>Sandusky, OH</td>
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The session started with a short introduction by the participants of themselves and their planetarium. After the introduction, the chairman proposed, following the experience of the previous workshop on the same theme, that we should keep to didactical problems, leaving out technical and economical items. The workshop agreed to this.

The secretary began to report on the production of shows for children in his planetarium. The first show became quickly very popular but it was soon realized that the audience did not really understand what was going on. A second production
followed, on a somewhat lower level of understanding astronomical events, but with a much higher didactical standard, yet very entertaining. This show has since several years been the standard programme for children 7-11 years of age. One person replied to this that it is very important to stay strictly to the school curriculum so that the planetarium show follows the education in the class room gently. One delegate said, that the planetarium people must explain to the people why they should go to a planetarium. Why is the planetarium better in explaining astronomical phenomena than the black board in the class room? Someone said that, why should we study astronomy at all? This question, however, was at least on a certain level, easy to answer: Astronomy is the most popular science among pupils. On the other hand it may be the least popular science among teachers. The question could also be answered with another question! What is out there......... It is necessary for men to investigate and explain the universe of which we are a small part.

One delegate spoke in favour of teacher's packages, information material for the teachers, about the show they are going to visit their classes. The packages are sold to the schools. One person pointed out the possibility to use flashlights dispersed among the audience which uses them as pointers during a live conversation. In this context it should be pointed out that about half of the delegates make "live" shows in their planetaria. It was the general opinion that some time for questions from the audience after a preprepared show was an essential part of a planetarium visit.

The problem of describing sizes of e.g. the planets and the solar system was discussed. One participant mentioned the possibility to measure e.g. the diameter of the earth in relation to the size of one's own country. Another delegate is using the planetarium dome as a model of the sun, the earth being big as a soft ball. The distances of the planets from the sun can then be described as well-known locations in the city. One person spoke about the importance of being correct, particularly when speaking to children.

One participant mentioned also that practical problems may hinder pedagogical ambitions, and this seemed to be a well-known thing. Disorder among young audiences was also a common experience with different solutions.

The above-mentioned problems are of course only a part of the whole discussion. The participants expressed in general satisfaction with the discussions, even if it had been easy to continue for many more hours than the 3 hours given.

Some short conclusions were:

We will all be spiced by the ideas given here.

We will take back a little something of all of you.

The session was then closed by the chairman.

ASTRONOMY EDUCATION IN SMALL PLANETARIUMS

Mariana Back and Alan Friedman

Leaders: Mariana Back, Borlange, Sweden
Alan Friedman, New York, USA

The other participants were:

Edward Buckwitz, Jr.            Bethleh, PA  USA
Don Bloom                        Bozrah, CT  USA
Tom Bullock                      Saratoga, GA USA
Peter Connors                    Miller Place, NY USA
Laura Daines                     New York, NY USA
Mona Engberg                     Borlange, Sweden
Dale Etheridge                   N. Las Vegas, NV USA
Silva Fernkrist                  Borlange, Sweden
Ian Giddings                      Scotland  UK
Alan Gould                        Berkeley, CA USA
Jane Hastings                    Richmond, VA USA
Linda Irby                       Dallas, TX USA
Mogens Irlind                     København  Denmark
Eloise Koonce                    Richardson, TX USA
Gunilla Matisson                  Molndal   Sweden
Joseph Hoffinger                 Adrian, MI USA
Donna Pierce                     Dallas, TX USA
Sheldon Schafer                   Peoria, IL USA
Dale Smith                       Bowling Green, OH USA
Lorna Waddell-Kremer            Rochester, NY USA
Robert Wagner                    Easton, PA USA

This session dealt with challenges and their solutions for the operation of small planetariums. The session began with each participant providing a self-introduction. A wide range of backgrounds of the 23 participants was apparent, with 9 entering the planetarium field from careers in education, 5 from careers in science, and the rest from a variety of professions.

As each participant listed particularly important challenges he or she faced in the planetarium, many mutual concerns became apparent: "Oh, yes! that's my problem too" was a frequent response as each challenge was being described.
This list collects the challenges discussed in several categories:

**Pedagogy**

- How much material should be covered in a school program.
- How much astronomy should be included in a public program.
- How to integrate astronomy and other sciences.
- What astronomy materials are good for use outside of the dome.
- What to do about inadequate and inaccurate textbooks.
- What to do to help classroom teachers who do not know how to make use of planetarium resources, and who are afraid to teach astronomy.

**Equipment and logistics**

- How to obtain adequate ventilation, especially in an inflatable like Starlab in the summer.
- How to find reliable, battery operated light pointers, especially for audience use in participatory programs.
- How to solve location problems, for example school bus group access to a planetarium in the middle of a college campus.
- How to provide cove lighting in an inflatable planetarium.
- How to provide services in rural areas, over large distances.

**Professional and administrative concerns**

- How to convince school/museum administrations of the importance of planetariums.
- How to obtain adequate budgets for staff, materials, conference travel.
- What can be done to relieve the isolation of single-person run planetariums, especially in regions with few planetariums.
- How to justify the effectiveness of planetariums to teachers, administrators, and other education leaders.
- How to obtain additional staff.
- How to arrange for succession when a one-person planetarium's director leaves or retires.
- What to do about the lack of routine critical reviews found in science and other professions.

Most of the workshop was spent discussing solutions to these challenges, and mechanisms for exchanging challenges and solutions in the future.

Alan Gould described a set of materials designed as solutions for two of the challenges on the list: "How to integrate planetarium and classroom lessons," and "What astronomy materials are good for use outside of the dome." The Planetarium Activities for Student Success series of 8 volumes, published jointly by the Lawrence Hall of Science and the New York Hall of Science, was designed to provide pedagogical background and lesson modules for communicating astronomy at various grade levels using both planetarium and classroom components. The materials were developed to be used by teachers, not just by planetarium educators, so they should also contribute to the challenge of "What to do to help classroom teachers who do not know how to make use of planetarium resources, and who are afraid to teach astronomy."

Mariana Back discussed the challenges of developing the planetarium in Borlange, in a region with very few planetariums and little awareness on the part of potential audiences. Contacts developed at the meeting have provided leads to a number of pedagogic and technical solutions for specific problems; and the arrival of hundreds of planetarium leaders from around the world has dramatized the importance of the planetarium for administrators and audiences alike.

Solutions to specific challenges on the list were offered by many participants. **Pointers:** newly introduced laser pointers for under $400 meet the need for reliable cordless pointers for planetarium operators; for students, a $30, heavy duty pointer was described (and several people volunteered to obtain and disseminate manufacturer and purchasing information). **Cove lights:** Velcro fastenings (a strip of the fuzzy part run around lights to the dome, providing the needed cove lighting system for inflatables. Velcro sets have also been used to attach posters, instructions, pointers, and clipboards to a dome for participatory programs.

**Staffing:** Volunteers have helped provide additional staff for many planetariums. Some planetariums have used students, honor societies, or teacher interns, offering credits in lieu of pay; retirees with valuable skills have helped other planetariums; and "ham" (amateur) radio operators have a variety of electrical and electronic skills and have proven eager to apply their knowledge to meet planetarium needs. **Critical reviews:** inviting a colleague in the profession, especially from another country, to review your program or operation can provide a powerful tool for convincing administrators of the value and standing of your planetarium.

As workshop participants discussed many individual challenges and solutions they had found, the discussion turned to just how to continue valuable exchanges like these. Unlike the larger planetariums, which typically have staffs to share information...
intensively and funds for travel to share information externally, small planetariums are often operated by one person, in relative isolation. Many solutions for many problems are probably out there in the small planetarium community; the general solution is more sharing and more communications.

"Sister planetariums" (modeled on "sister city" programs) were suggested as a way of overcoming isolation, providing the prestige that comes with international contacts, and starting a network for communications. Discussion noted that planetariums need to be matched carefully, however, so that the needs of one correspond to the resources of the other. There was much enthusiasm for starting up a sister planetarium program, as well as keeping up less formal networks.

Participants also stressed that in addition to formal partnerships for sharing challenges and solutions, simple information exchanges are also important. For example, the request by one participant for information on celestial navigation curricula was immediately answered by another participant whose planetarium had been established for the purpose of teaching celestial navigation!

In addition to the concept of sister planetariums, participants suggested setting up a "personals" style column in the Planetarian: "Small planetarium in Denmark needs lesson plan for lunar eclipses suitable for 10-year olds" was an example of what such a column might contain. Plans for a small/portable planetarium column in the Planetarian were mentioned, with the idea of using such a column to match sister planetariums, and to list individual needs.

The workshop ended with numerous individual exchanges of information. There was agreement on the vital importance of increased sharing, and the establishment of mechanisms for networking and planetarium-to-planetarium relationships. The establishment of these mechanisms should prove fruitful topics for task-oriented working sessions at future IPS and regional meetings.

FIGHTING SCIENCE ILLITERACY FROM THE PLANETARIUM

Dave Hostetter

"Science illiteracy" is becoming a serious problem in the United States. Part of the problem may be unfamiliarity with the process of the scientific method. Although this is most effectively handled in the classroom on a regular basis, there are ways for museum-based planetaria to help solve the problem. In the last two years the Lafayette Natural History Museum has begun an informal program of activities designed to help teachers and students with the scientific method.

While judging a middle school science fair a few years ago, I asked each of the 17 entrants whose projects I was judging if he or she had ever heard of the scientific method. Out of the 17, 15 claimed never even to have heard of it! Of the two who had, only one had even a vague idea of what it might be. I later overheard the kids telling their teacher what I had asked. Her response was, "You remember the scientific method -- we talked about it at the beginning of the school year."

I thought that episode spoke volumes about one aspect of the crisis in US science education. If students are not learning about the scientific method, then much of science must look pretty much like magic to them -- a set of answers with no way to know if they are better or worse than other possible answers. They would certainly not know how scientists update our knowledge and learn new things.

When I reviewed our local science texts, I discovered that concepts such as the scientific method, experiments, controls and variables, hypotheses, and theories were not even indexed in the texts in use through 6th grade (Barufaldi et al., 1981). Some of these concepts were not included in the 8th grade text, either. The result may be that our local students are not being adequately introduced to these critical ideas. (When these concepts are introduced, they may be done poorly -- for instance, the 8th grade text used
I suspect that lack of familiarity with the heart of science is one of the main factors in US science illiteracy, including the inability to tell legitimate science from pseudosciences like UFOs, creationism, psychic powers, and the like. I think a basic understanding of the scientific method is pretty important for adults as well as students.

At the Lafayette Planetarium we are now trying to include the scientific method in more of our programming, and are discovering that this is a subject that is difficult to teach effectively and difficult for people to learn. Perhaps a planetarium that an individual class may visit for less than an hour every couple of years is limited in its effectiveness in teaching something as basic and complex as the scientific method. That may need to be handled mostly in the classroom, not by mentioning the scientific method in passing at the start of the year but by repeatedly using it in classroom activities throughout the year.

Despite this, there are some things planetarians can do beyond regular programming to help bring a basic understanding of scientific inquiry to students and the general public. Our planetarium’s efforts in this are still rather tentative, and include both successes and failures.

Try making presentations at school inservices on any level: state-wide, system-wide, or at individual schools. Presentations at science teacher conferences can be effective, too. Our presentations have particularly targeted science fairs, suggesting that they be used to produce projects utilizing the scientific method instead of projects using simply posters and reports. We hand out science fair teacher information booklets (often available from regional utility companies; see “Your Guide,” 1984), along with details such as possible multi-month project calendars.

Another popular handout is a listing of possible projects; we don’t pretend that it even comes close to exhausting all the possibilities, but it can give a teacher an awareness of the types of projects that can be done (from simple to complex; with or perhaps stimulating student inventions. We also remind teachers of such excellent resources as the magazines, “Science & Children,” and “The Science Teacher,” from the National Science Teachers Association (Teachworth, 1987; Stedman, 1975; Smith, 1980).

Of course, doing this puts a planetarium staff into a delicate position: we don’t want teachers to perceive us as just another bunch of outsiders trying to tell them how to do their jobs. Happily, I have found teachers to be uniformly receptive to our programs and enthusiastic about getting some actual science into their science fairs.

Sometimes they seem relieved to hear someone else saying things they may have been thinking themselves. Our presentations seem to be effective; the schools we’ve worked with most closely have had noticeable changes in the scientific content of the average project.

It is also effective to volunteer to judge local science fairs at individual schools. This provides an opportunity to speak with teachers on an individual basis (even those who don’t regularly visit your dome), and can be highly valued. This can be very time-consuming, though, so you may need to limit how many you do each year.

We also try to work directly with the students. Like most planetarians, we have for years worked with individual students who contacted us for help; however at one school we were given the opportunity to do in-class presentations for the sixth and seventh graders about using the scientific method in science fair projects. It was quite successful, and the science faculty there thought the students had increased enthusiasm for the science fair that year.

We are now inserting more of the scientific method into our children’s workshops and Young Astronaut activities. Our 4th through 6th Grade Young Astronauts have designed experiments to determine the speed of sound from a videotape of a Shuttle launch, to search for variations in the sprouting of seeds depending on whether or not the seeds had been accelerated on model rockets, and to measure Earth’s acceleration due to gravity. They also participated in NASA’s LDEF SEEDS project. Incredibly, this has all been so popular that they actually ask to do even more experiments! One advantage of working with a group of this type is that in traditional schools, kids are exposed to the scientific process in several ways so they don’t get an oversimplified cookbook approach. An important part of this is for them to learn how to think rather than what to think.

Experiment-based summer workshops have been less successful, with few kids signing up even when something as popular as model rockets is involved. Science demonstrations and model rocket "fun launches" work well, but apparently even simple experiments are unpopular when school is out.

We will keep trying these types of activities, particularly in our Young Astronaut Program (which provides an excellent testing ground). In coming years we hope to develop a "scientific method" program to be presented in middle schools each year by volunteers. Programs for adults in this area may be still another project for the future.

In addition to developing planetarium presentations, it is possible to fight science illiteracy individually. One way is to work with your state’s science curriculum review
committe. Most planetarians have seen enough students and 
teachers to have a feel for where some of the weaknesses in 
science education are; find out how often the curriculum is 
reviewed and write a letter expressing your opinion.

Another way is to find out when your local science texts are 
being reviewed. Proposed new texts are usually put out for 
public scrutiny during the acceptance process; review them 
and write an intelligent letter about their strengths and 
weaknesses to the proper committee. Look for the quality of 
treatment about key items such as the nature of theories and 
hypotheses, and the nature of the scientific process. See 
if the scientific method is used in recommended classroom 
activities throughout the year, or is mentioned in the first 
chapter never to be referenced again (two options that send 
very different messages to students). Check the general 
accuracy of the contents, and how important concepts such as 
evolution are handled. Just be careful about the size of 
this job, too. When I stopped by my local school board to 
look over the proposed texts, I found a planetarium-sized 
room literally filled wall to wall with piles of books!

Although learning about the scientific method is only one 
part of the battle against scientific illiteracy, I strongly 
feel that it is a critical part of the battle. Until the 
general public becomes aware of this fundamental concept, 
scientific illiteracy will be an important problem; 
fortunately, we can help do something about it.

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HOW TO DEBATE AN ASTROLOGER
John Mosley

Recently, we heard that Nostradamus predicted a major earthquake for Los Angeles, and 
that the First Lady consulted an astrologer to arrange the President's schedule. This 
paper is based on what I learned then in discussing and debating astrology on radio and 
TV programs and in preparing an astrology/pseudoscience planetarium show. It is pri-
marily directed to people who will discuss astrology with the media, especially in a 
confrontational setting (debate or interview), and secondarily to producers of plane-
tarium shows about astrology in specific or pseudoscience in general.

Be prepared; be brief
There is no time to fool around. Answer in 20 seconds and don't use big words.
Prepare an agenda in advance.
Have a mental list of a few points you want to make, and be sure to make some.
Don't remain defensive; take the offensive if necessary to work from your agenda.
TV is a visual medium—bring and use visuals, including hand-held props. Use surprise.
Use anecdotes—tell stories about people, and use some drama and humor.
Use direct and forceful language and arguments.
Avoid surprises by having answers for anything your opponent might throw at you 
(and it helps to anticipate in advance their stock answers to your challenges).

Be sympathetic, not arrogant
Don't dismiss astrology (you will be seen as arrogant and lose sympathy).
Don't appeal to authority (the audience won't care).
People trust their own personal experience more than a hundred scientific tests.
Show why astrology often does seem to work. (Exude wisdom; show that you understand 
more than the astrologer; your confidence may throw the astrologer off balance.)

Points to score
"Cold reading" is at the core of astrology's success (and fortunetelling in general). 
Astrological jargon is a mumbo-jumbo smokescreen, even if astrologers use computers. 
People need to believe and to have answers; astrologers satisfy a market demand 
(but are they practicing pop psychology/therapy without a license?).
As a what's-your-sign game, it's fun; if it prevents needed therapy, it's dangerous.
19 out of 20 people will claim a generic horoscope as their own.
Astrology is not "ancient wisdom"; it has a specific origin in time and place.
Astrology did not predict three planets (a major oversight!).
Astrology is fundamentally pagan, and conflicts with all major religions.
Astrology is easy to disprove scientifically
(but avoid details—there is too little time and the audience won’t care).

Why the moment of birth, not conception?
The forces within the solar system are understood well (ex: Voyager to Neptune).
Most astrologers don’t know the cause of tides or who discovered the explanation.
Note: the female monthly cycle is not related to the length of the month.

Have answers to: “the stars impel but don’t compel,” “astrologers only interpret,”
“astrology is an inexact science like medicine,” “horoscopes are like X-rays” etc.

ASTROLOGY IN THE PLANETARIUM
WORKSHOP

George Reed

Eighteen people attended the workshop. The purpose of the workshop was to demonstrate
the difference between astrology as a “science” and astrology as an “art.” The workshop was
conducted on the assumption that only by understanding the mechanics of astrology can a
planetarium educator intelligently counteract the influence of astrology.

The participants cast their individual birth charts as an example of the astronomy, or science,
involved in the practice of astrology. The participants also attempted to interpret their
individual birth charts, using information taken from astrological literature, as an example of
the highly subjective “art” involved in the practice of astrology.

The participants were finally given the birth chart of a historical figure and challenged to
determine the person’s identity from the astrological clues.

Jeanne Bishop ended the session by providing her observations and recommendations con­
cerning astrology from her in-depth study of the problem.

The session was held in an informal atmosphere with almost everyone contributing to the
discussions.
TEACHING HEARING-IMPAIRED STUDENTS IN THE PLANETARIUM

Gloria D. Rall

ABSTRACT

An astronomy course for the hearing-impaired is described. Students read linguistically controlled material from a computer screen. Combined with the visual capabilities of the planetarium, students learn more material more accurately than when interpreters are used.

INTRODUCTION

Several years ago I and a special education teacher for hearing-impaired students decided to develop an astronomy course for hearing-impaired students. The course was to be centered around the planetarium. Sign language interpreters are the normal mode of instruction for hearing-impaired students. There are, however, some very serious detriments to interpreters. An obvious one is that the interpreter requires a light source that can be disruptive. Less obvious, but just as real are other problems. American Sign Language (ASL), which is the sign language most commonly used in the United States, has neither the structure nor the vocabulary to effectively convey many scientific concepts. Moreover, unless interpreters are trained in science, they make mistakes, even at an elementary instructional level. Lastly, but importantly, the students tend to develop rapport and dialogue with the interpreter rather than the instructor.

For these reasons, I decided to substitute reading for the interpreter with the material presented on a computer monitor. A little experimentation demonstrated that the light level from the monitor was acceptable, and that the material on the screen was clearly visible.

Reading, however, poses problems for hearing-impaired students. Nearly all these students are impaired at birth. Therefore, they totally lack language experience. Preschoolers often do not even know of the existence of words (Kyle et al., 1985). In contrast, the hearing child, in the preschool years, acquires vocabulary and syntax, learns idiomatic speech, and develops inference drawing skills.

The majority of hearing-impaired children begin to learn language when they enter school where they are expected to learn language and reading simultaneously. Most simply don't. Few achieve more than a fourth-grade reading level with concepts of language structure and vocabulary severely limited (DiFrancesco, 1972; Trybus et al., 1977; Conrad, 1977). However, differences in language ability among the hearing-impaired are differences of degree, not differences of kind (Bochner et al., 1981). As a result, rules, analogous to English grammar rules, have been developed to construct written material for the hearing-impaired. Material so written is called linguistically controlled material (Decker et al.)

Let's examine material rewritten for linguistic control. The following four sentences are taken from a well known children's astronomy book (Branley, 1981) and rewritten by me.

"Jupiter is the biggest of all planets."
"Jupiter is much bigger than earth."
"Suppose Jupiter were a large, hollow ball. Over 1,000 Earth's could fit inside it."
"The slide shows the sizes of Jupiter and Earth. Look at the slide ..."

The slide shows the sizes of Jupiter and Earth. With hearing-impaired students, visual material is always more effective than words. The level of instruction was another consideration. Hearing-impaired children are continually excluded from both formal and informal learning processes. By the time school
is entered, the child is seriously lagging in development of the skills, knowledge, and concepts that contribute to academic success. Moreover, science is usually totally excluded from their curriculum. Thus, these students had no preparation for my course—which was their first science course. For instance, hearing-impaired children of seven or eight often have not learned the concept of direction and do not possess the vocabulary for the cardinal points. So a planetarium lesson on Polaris should teach the concept of direction, the vocabulary for the cardinal points, and the importance of Polaris.

The course, as finally developed, was not only a remedial course in astronomy, but a remedial course in many concepts basic to science. The goal was to enable the student to enter a regular elementary school curriculum in astronomy. The lessons were programmed in Basic. The students read, as a group, the material on the screen. When all had finished, striking any key caused the material on the monitor to change. When eyes were not on the monitor, they were directed back by a subroutine that created a noticeable, blinking light from the monitor. Another subroutine permitted interruption of the programmed lesson from the keyboard. Thus, questions could be answered and extra material presented. This created the spontaneity of the regular classroom and allowed the full range of normal interaction between students and teacher. The students learned to work with me, and rapport developed. Lessons were activity oriented. Students were required to answer questions, do demonstrations, etc.

Lessons in the planetarium were supplemented with lessons in the regular classroom taught by their regular instructors. One hundred students participated in the course for three years. It became one of their favorite subjects. Because of language problems, hearing-impaired students do not do well on written tests. However, that they learned well was obvious by comments and references back to material studied months or years previously.

Certain differences between hearing-impaired and hearing children became very obvious. Hearing-impaired students are acute observers. For instance, these students always learned and remembered constellations with one demonstration. Therefore, they learned the sky much faster than hearing students and retained the knowledge all through the course. When shown photographs of planets they were much quicker to note differences and similarities and to begin spontaneously to draw conclusions from their own observations. Because of this ability a great deal of emphasis was placed on structuring lessons around visual material with students encouraged to develop critical thinking skills.

With emphasis on visual material, the planetarium with all its projection equipment was an especially ideal classroom. Nowhere in the literature on the hearing-impaired is it noted that people compensate for deafness by becoming acute observers. The students' regular classroom teachers were surprised to discover it and surprised that their students far surpassed hearing students in some learning situations.

On the other hand, the students had a great deal of difficulty with some material and did not learn as well as hearing students. Any material requiring spatial skills was very difficult. Thus, they did not acquire a clear understanding of geometry of the solar system and the motions of the planets or the ability to relate what is happening to what is seen in the sky. Abstract concepts were also difficult for them, and they did not achieve a good understanding of some of the chemistry and physics of astronomy.

There were some puzzling anomalies for which I can't account. Mythology and history totally puzzled the students. They seemed to lack skills that would allow them to assimilate these aspects of astronomy.

They did not cover as much material as hearing students in an equal amount of time. The students read slowly and required time to think about what they had read. Moreover, much time and effort had to be devoted to teaching material that hearing students would already know. Students under the age of nine or ten had such poor reading skills they could do little more than learn the sky. Because of the severe language problems, new vocabulary words were held to the absolute minimum. As a result, the students did not build the astronomical and scientific vocabulary of hearing students.

In conclusion, reading seems to be a feasible method of teaching hearing-impaired students in the planetarium. Combined with the visual capabilities of the planetarium, students probably learn more than when an interpreter is used. They certainly learn more accurately than with an interpreter. Developing the lessons on a computer permits the flexibility and spontaneity of the regular classroom with rapport developing between instructor and students. In turn, the instructor is constantly able to make the subtle changes and adaptations necessary to success in any classroom.
My name is Franck Pettersen. I am the science director of the Northern Lights Planetarium, which is also the planetarium on the top of the world. Tromsø is approximately 370 miles, or 600 km, north of the arctic circle. This geographical position gives us midnight sun for two months, and 10 to 12 weeks of daylight 24 hours a day. To us these nights in Borlange are dark summer nights. People keep asking how we can sleep in the summer when the sun is shining through our bedroom window. And that is the wrong question. In the winter, we are getting punished for all this light in the summer! For two months the sun is gone. The daylight is seen for two to four hours in the middle of the day. But we have the Northern Lights flaming in the dark winter sky.

Tromsø is exactly in the strongest northern lights zone. Under the auroral oval, and when we decided to build our planetarium, it was natural that our main attraction had to be the northern lights. During a three months stay at Lawrence Hall Of Science in Berkeley, California, I developed a program about seasons and light above the arctic circle. They had an unbreakable rule at LHS: there had to be at least three activities for the visitors in the programs. Later I have adapted these activities to school visits in our own Planetarium, which has a 12 meter horizontal dome. And it is these ideas that I want to share with you here.

The first activity was not about the northern lights, but about the sun north of the Arctic Circle. One of the pedagogical ideas was to learn about the differences in seasons in the north compared with the south. Other things were: what causes the seasons; why do we have midnight sun; what does it look like in the universe; what does it look like from the earth? etc.

We started with showing sunrise, sunset and the sun's path across the sky at 40 degrees north in the middle of the summer. Then the students were given small arrows with hooks on, and they were encouraged to make a guess and to put their arrow on the horizon in the position where they thought the sun would set. It was emphasized that the midnight sun is shining this time of the year. But it was an amazingly large number of people, even adults, who did not seem to realize that midnight sun meant that the sun will not set at
The next activity is my favorite because the result will be a baseline in nature of about 90 kilometers. A beautiful effect, and as a matter of fact the phenomenon is very closely related to what happens when the auroras themselves light up the night sky. The next activity is an old one, and most every teacher in the primary school has used it at one time or another, but we gave it an extra twist! The aim was to learn about the colors in the northern lights, and the activity was of course then to draw a northern lights display. There are a few distinct colors in the northern lights, and most people even in Tromsø don’t know that. The color that dominates 99% of the time is a green color with a wavelength of 558 nano meters. The other colors that can be seen are one violet, two blue ones and four different red colors. We gave as a handout a black piece of drawing paper with a drawing of a landscape at the bottom. The students were then supposed to choose the right colors, and make a drawing of the northern lights above the landscape. The extra twist was that these colors were fluorescent colors, so that when the lights were turned off, there they were looking at their auroras, glowing in the dark. The students were then supposed to choose the right colors. And to share one of my special tricks with you: It is never difficult to see what is up and what is down when you see a picture of the northern lights. For instance if this picture. Is this the right way, or is this? The lower edge is always the sharper one, so this is the way it should be viewed.

For students in primary school, I will plan the activity like this: Explain to the students that the height can be determined if you measure the angle above the earth from two different places at the same time. Then use the same situation in the planetarium. Project a picture of the northern lights on the dome, and have the students measure the angle from two different places. If the special point in the northern lights you are measuring at is 45 degrees up on your dome, and the measurements are done from the middle of the theater, and from the back of the theater. Then you can tell your students that this is equal to a baseline in nature of about 100 kilometers, the result will be a height of approximately 90 km. As soon as your students are old enough to use the compass, they can solve the problem geometrically. Let 10 centimeters be equal to 100 km. in nature, and have the students draw the two angles. They can then measure the height from the special point in the northern lights and down to the ground level. For older students I will do the same measurements, but let them do the calculations with the help of trigonometry. I will also change the instrument to this one that enables you to measure angles with an accuracy of about 10 minutes of arch +/- 5 minutes. (Show and describe the ruler) That is very good for such a simple instrument. We are talking about age groups of 17 and 18 years olds, if they are norwegian students. If they are 18 or 19 years old, like my students from last year, I will use a more accurate and more sophisticated version of the measurements. I will use two different slides of the same spot in the northern lights, taken at exactly the same time and from points separated by 100 km. In the projection in the theater, I will match the background stars in the picture with the starfield in the theater. The starfield is then of course in a position of the correct latitude and time of the exposure. Do the same for the other picture, measure from the center of your theater. This will provide every student with a very accurate set of data for determining the heights of the northern lights. Using the method of triangulation.

The last and most difficult level is to make the triangulation in three dimensions and if you have access to a sextant, that will add even more for the special interested students. The calculation itself can of course be found in different textbooks, or you can develop it yourself. The problem and the solution looks like this: (Show the two different solutions) If you have any questions, I will be happy to answer them. And I hope that I through these two presentations that I have given, I have motivated you to visit Tromsø, and The Northern Lights Planetarium; and not only in the summertime with the midnightsun, but also in the winter with the magnificent and majestic auroras.
BRING YOUR OWN SLIDES
Luis Pujol

ABSTRACT
This paper summarizes how we have developed a participatory program for children. They participate in the show singing, answering questions and also in the illustration of the show, bringing to the planetarium their own slides.

INTRODUCTION
Since two or three years ago we have detected an increasing interest in coming to the planetarium with very young children. Our answer to this situation has been to produce a show specially designed for them (ages 5 to 8) with the following peculiarities:

a) The children must participate in the show.
b) The show must be free of abstract concepts.
c) The children must learn.
d) The visit to the Planetarium must be a funny time.

Of the above characteristics, the most difficult to overcome, is to reach a true participation, and there we have concentrated our efforts.

THE SHOW
Having in mind those peculiarities, we have designed a show following an scheme that I think every planetarian has followed: a trip to the space, to describe the Sun, the Moon, planets, constellations and so on.

The story tells about a group of boys and girls that have gone to the planetarium with their teachers. The voices are those of John and Ann (the teachers), two narrators and a group of children.

The show starts with a classical "Once upon a time..." and after an introduction, the Sun rises. But this Sun appears just after the boys and girls have called him singing a song.

To accomplish this first level of participation, we have used a very old and popular song, that more than ninety percent of our children know perfectly. With the collaboration of the teacher of music of a school, we have made a tape recording of that song with the voices of a group of children and the accompaniment of a piano. We inserted it at the appropriate point of the show, and in reaching that point, the narrator invites the audience to sing.

The same thing happens with the Moon, Mars, a comet... each one with his own song.

Just after rising, the Sun talks to the audience and explains that during the morning he is going up, and in the afternoon goes down; what he does to make day and night; and while setting, he introduces the Moon and the stars. The Moon is crying because people says she is a liar, because when she looks like a C is not Crescent; the Pole Star serves as representative of all other stars and talks in her name; she tells a story involving some constellations that we point in the dome, and so on.

At that point, I realize of the restriction imposed to the show by the existence or not of those popular songs in each country.

ONE MORE STEP IN PARTICIPATION
The slides we use to illustrate the show, are of two kinds. Some ones are actual pictures of the celestial bodies we are describing, while others are drawings made by children. To obtain them, we have been very lucky in obtaining the collaboration of a school, where we have been working with the teachers explaining the children what we were going to do and what we needed for it.

The result was a large set of drawings made by boys and girls of different ages, that next school year will be exhibited in our main hall, and have been the source of an important set of slides.
The next step is to meet with the teachers interested in the show, to see it and explain its objectives. Then we will propose that their pupils make some similar drawings, from which they can obtain slides to bring to the planetarium the day of his visit.

In our carrousels we have marked some definite slides that we can change in a couple of minutes. Then, in running the show, the children will see their own drawings projected on the dome.

ACKNOWLEDGEMENTS

We wish to thank Mr. Pere Sureda, director of the school La Miranda, the music teacher Miss Silvia and all the boys, girls and teachers that have collaborated with us, making possible the production of this show.

AUTOMATED SCHOOL PROGRAMS AT THE BOCHUM PLANETARIUM

J. V. Feitzinger, M. Hunerbein, U. Lemmer, and J. Prolss

Abstract

Experiences with automatic planetarium-shows for young pupils are presented. It is possible to match the intentions of the teacher as well as to entertain the young visitors. The quality of these shows depends on thoroughly calculated and well styled concepts. As an example some of the reactions of children of the age group 9 to 11 years are mentioned. The principles of the automatic system, designed and installed in 1986, are described (Fig.1).

A. Reasons for automaticisation and technical

Our planetarium was opened in 1964 and has an instrument Zeiss Mark IV and 300 seats. In 1986 the Planetarium Bochum received a new projection-dome. At the same time the old Planetarium projector was reconditioned. To participate in modern planetarium development, an automatic system was designed and installed. The projector was modified and connected with the automatic system in February 1990. Now all shows are on a professional high, educational and well styled standard. This is especially important for pupils, who should also have entertainment during the astronomical lessons. The Planetarium Bochum doesn't intend to present pure school-lectures. (Lit: [3];[4])

A PC controls up to 256 intelligent interfaces. Each unit controls 4 projectors. Special interfaces are used for the panoramas and the planetarium projector. All functions are mentioned in figure 1. Each of the main functions can be switched to the original hand-controlled manner. During automatic running an overwrite modus for all functions is active.

B. Advantages of automated schoolprogrammes

Advantages for public shows have often been discussed. Advantages for school shows are:
In a thoroughly planned program you can realize an optimal didactical concept with more pedagogic effects than in a life-show. (Lit: [1]) Automatic running performances present a professional show to pupils, who are familiar with TV-shows and forget to be in a planetarium-school-show. The teacher can receive the complete text, so very good and effective cooperation with teachers will result. Shows do not depend on the speaker. The teacher can be sure to see the identical show with his next class. The lecturer/astronomer is relieved of teaching; work can be invested in the production of new planetarium shows. An automatic show can be run by the technicians. The questions after the show are handled by an astronomer. Large numbers of visitors can be satisfied without problems, even if it is necessary to present an additional show with another theme. Our tests yield very good resonances. We are producing many shows for different ages at the same high level, even in English and French language.

C. OUR EARTH IN SPACE; an example for the age group: 9-10 years

Content: The Sun is great and hot, our home star; helio-centric system: comparison of the times of orbit of the planets; pupil's count: Mercury finishes 4 revolutions during one year; space-ship visits Venus (cloudy, very hot) and Mars (cold) (Fig. 3). Earth is the only planet to live at; Earth is rotating, therefore night and day rise; Sun is moving; stars; star-pictures; motion of the stars; ancient fairy-tale: great bear touches his legs in Greek ocean, he has no refreshing bath; Milky Way a ribbon; question: Can the Milky Way be a sphere? No, the Galaxy is a disk; planet's motion (especially Mercury) in front of the distant stars; question: How often has Mercury overtaken our Earth?

First resonances: Acclamation during the show, addition of another topic; question: Who has moved the stars or ourself? Teacher: Age-matching pedagogically well thought, matching our preparation and expectation. In the opinion of the pupils the show was very good, it could have been lasted for a longer time; children make use of the possibility for questions.

Experiences after 2 years: As an example we would like to mention some of the children's reactions to the topic. The explanation of the temperature of the sun: "Astronomers have found that the sun is very hot" - murmuring "At their surface there are about 6000 Celsius" astonishments. It is difficult to measure such temperatures" (slide, fig.2) - laughing.

Here we follow 2 pedagogic concepts: - starting from well-known and going to unknown topics
  - I heard - and forgot
  - I saw - and remembered.

We present a multimedia-show with modern technic. At calculated times children's laugh regularly rises. Children are accustomed to TV and quick sequences of pictures, therefore in this planetarium-show 43 slides are used. Often we are asked: When does this MOVIE run again?

Learning embedded in entertainment revealed its success; discipline has risen. There are no disturbances even during question to the children. Active cooperation: If there is a wrong response, the other children laugh or they are calling the correct answer. A show-like demonstration causes the apprehension to miss something.

Teachers will often have explained the whole universe in one lesson. This we do reject! Like a menu the teacher can choose 2 to 3 themes; more different topics will be presented during another show and another visit.

D. School situation in North-Rhein-Westfalia, summary.

In NRW there is no curriculum for astronomy. Only with activity of the teacher astronomy can be given partly, mainly in Mathematics, Physics, Common sciences or Ecology. Often very young children are highly motivated to deal with astronomical themes. This leads to different levels of preparation of planetarium visits. (Lit: [2];[8])

A planetarium is a substantial source of information for teachers. A visit is a compact school lesson. After a first visit the desire arises for the next visit of a planetarium. We give arguments that it would be the best if the visit of a planetarium is a fixed part of school-lectures. (Lit: [5];[6];[7])

We plan to install a system with closed thematic topics, which can merged to an individual show, according to the intentions of the teacher.

Here have been presented experiences with the age group 9 - 10 years. Meanwhile we have very good results with automatic shows even for age groups 6 - 8 years.
E. References


EDUCATIONAL PROGRAMS IN MONTPELLIER PLANETARIUM

Jean-Michel Faidit

ABSTRACT

A small planetarium, whose calling is school, has been running since November 1989 under the former observatory in the Montpellier Botanic Garden, restored to that end.

Since the amount of children accommodation is limited to 15 seats, farms are divided in two groups taking turns to astronomical show and walks in the paths of the Botanic Garden.

With this paper reading, the speaker describes the educational methods practiced in expectation of the setting up of a large planetarium, with a regional school calling.

PAPER READING

Planetariums gives among other things, a possible recreation of a picture of the sky at classes hours and such an educational vocation is one of the important specificities of that modern instrument of communication.

The way of conducting the scientific broadcast depends on the size of the projection room.

One of the advantages of big planetariums lies in the fact that the spectacular effects who go with educational programs stimulate the spectators' interest. There's a variable amount, according to each planetarium, of recorded shows and of interactive parts, who usually tend to describe the sky of this particular night.

But in small planetariums, the limited number of spectators (less than 20 people) seems to favour interactive programs, particularly in the case of a young audience, like school children.

In France, as Agnès Acker, our "Association des Planetariums de langue française" (A.P.L.F.) president, has presented before, the development of planetariums was rather late. In the last 10 years, a reasonable amount of small planetariums grew, we can think they foresee a wave of bigger ones in the next decade.

It's the case in Montpellier, where we've experienced such educational programs in a small planetarium, set up under the old observatory 4-meters dome.

FROM THE OBSERVATORY ...

This building was erected in 1879 on a place considered as fitting studies in astronomy by Urbain Le Verrier in one of his visits in Montpellier in 1862 while planning to establish in the south of France a branch of the "Observatoire Imperial de Paris"; a few years later, the observatory of the Botanical Garden was equipped with a 20 cm diameter equatorial telescope of Foucault, a gift of Jean-Nicolas Legrand, Chairman of the Department Astronomy of the University of Montpellier for 30 years in this time.

... TO THE PLANETARIUM

On the central pillar, in the place of the old telescope which collected the light of the stars, a GOTO EX3 planetar projects their image on the spheric dome screen unfolded inside the pavilion, re-creating constellations and apparent movements, skies of different latitudes, position of planets at the evening of the visit, ...

Inversion of the movement of stellar photons which gives this pavilion a new celestial vocation that its founders would never have thought!

EDUCATIONAL PROGRAMS

First are the welcoming speech and the initiator talk about the planetar, the sky and the universe, which permits to have an idea of what pupils know about familiar stars, the Sun or the Moon. A luminous arrow can be lent to the kids as soon as the performance starts. That is a way of stimulating their interest for their each draw in turn, by themselves, illuminated shapes on the planetarium vault.
Although the performance is planned in advance, the organiser can follow his audience's discoveries in many different ways, according to the pupils' participation.

The educational contents of each program will depend on different forms: in France, for instance, the "Education Nationale" tends to begin teaching elementary notions of astrophysics in secondary schools, whereas apparent stars, real or obvious movements, the solar system are learnt in primary schools.

In big as well as in small planetariums, screens having the disadvantage of giving an illusion of a flat universe, it is to be hoped that slides projection and explanatory diagrams go with the performance, in order to give an idea of space, in the absence of models in the entrance hall: views of planets from space probes, cross sections of galaxies, orbit plans ...

It's also better the organizers to take turns at least every 2 hours not to alter the quality of the broadcast, because it's quite hard for them!
Outside the Big Dome

POPS is a three-week educational leadership institute in astronomy and space science sponsored by the Lawrence Hall of Science, the public science center at the University of California, Berkeley and co-sponsored by the New York Hall of Science. The institutes, held during the summers of 1989 and 1990 are directed by Dr. Cary Sneider and funded by the National Science Foundation and Learning Technologies, Inc., a manufacturer of portable planetariums. A total of 100 individuals from across the nation attended.

One of the major goals of the institutes is for the participants to go back to their region and serve as effective resource personnel for curriculum improvement and staff development in the areas of astronomy and space science. At the institutes, participants learned how to:

- Use a portable planetarium system.
- Present workshops for teachers on how to prepare exciting classroom activities that communicate important concepts in astronomy and space science.
- Provide planetarium programs in which students actively participate.
- Teach other educators how to use a portable planetarium in ways that are educationally effective.
- Identify school district support that is needed to enable teachers to improve their effectiveness.
Participants were actively involved in all aspects of the institutes. They were provided with the opportunity to meet and share ideas with other planetarium educators. They found that each of their colleagues programs was unique. This exchange gave them insights into novel approaches they might try with curriculum development at their home locations.

Participants received a wide range of experiences and resources for teaching astronomy and space science through classroom activities keyed to participatory planetarium programs. Resources received included a wealth of materials such as the Planetarium Activities for Student Success (PASS), Great Explorations in Math and Science (GEMS) and Project Starwalk series. While working and experimenting with the materials provided, participants developed valuable skills for use in designing their own one year astronomy and space science curriculum. Above all, those who attended came away with enthusiastic and imaginative ways to build lessons which use the unique environment of a planetarium to achieve a balance between education and entertainment.

Upon our return from this highly motivating institute we proceeded to implement some major changes in our programs. We restructured our planetarium presentations to increase scientific literacy through the use of inquiry and language arts skills. This resulted in increased enthusiasm among teachers and students as the actively participated in all lessons. We also found that a larger percentage of students were able to remain focused and involved in the process of problem solving.

The next logical step for us was to present plans to our area science advisory committee for developing an astronomy and space science curriculum to satisfy state and local mandates. The response to our presentation was extremely favorable and we proceeded to create a Kindergarten through grade nine curriculum. We then assisted teachers in the development of specific activities to coordinate this curriculum with their schools' needs. We will be training teachers to effectively use these activities in their classrooms throughout the upcoming year and plan to conduct inservice workshops to increase literacy and appreciation for astronomy among area educators. This will impact the entire community as increased understanding and awareness of the basic astronomy concepts enable people to view their world as precious link in the workings of the universe.

The strategies learned at this institute have proved to be very useful. Along with our students we have increased our ability to think logically and creatively. This was reflected in the fact that we were able to envision exciting new alternatives and greater flexibility in our approach to presenting planetarium programs.
INNOVATIVE OUTREACH STRATEGIES
Sheldon Schafer

ABSTRACT
In addition to a Starlab Portable Planetarium for outreach, the Lakeview Museum of Arts and Sciences conducts three other successful outreach projects.

1) Parental Involvement Program/Family Astronomy Series
2) Telescope Loan Program
3) Traveling Astronomy Library

These projects not only take astronomy out to the schools, but provide opportunities for the whole family to become involved in the participating students' astronomy units.

The parental involvement program originated as the consequence of a survey of parents from a local school in Peoria Heights, Illinois. Two thirds of the respondents indicated that they felt inadequately informed in astronomy and desired more background knowledge. It was a result of this interest that we conceived the parental involvement program.

The program has two main objectives: (1) to reinforce students' learning by involving parents in their children's prescribed astronomy course, and (2) to extend the present scope of our astronomy curriculum by coordinating five planetarium lessons with 5 lessons shared by the students and their parents.

Five major content areas were to be addressed: (1) constellations, (2) seasons, (3) nature and classification of stars, (4) lunar motions and (5) planets. Students were instructed in these areas following the classroom text. Following teacher-prepared lessons, students visited the planetarium for lesson review, content extension and orientation to assigned take-home observational activities.

For parents there were take-home materials similar or identical to those of the students. Parents and families attended five planetarium lessons which reviewed the students' material and prepared the students and parents for their at-home observational activities. These were offered Saturday mornings. Participation ranged between 50-70%.

The family at-home activities included:

1) Using the take-home star map to locate the constellations of the current sky.
2) Recording the sunset position twice a week for two months, from mid-February through mid-April, (when change is obviously more dramatic.)
3) Locating the stars of the winter circle and visually comparing their colors and magnitudes.
4) Observing Mercury in the west at sunset.
5) Observing Sunspots (if the proper home equipment is available).
6) Recording times of moon rise and set each day for a month. The observations were then compiled on a classroom wall chart.

As an additional incentive for attendance we made arrangements with a local pizza parlor to provide game tokens to all participants. This has proved to be very popular.

In an effort to broaden the impact of this program we tried two strategies.

1) We expanded the planetarium lessons to a 12 week series, incorporating the lessons of the participating schools along with those of non-participating schools, and opened admission to the general public on a walk-in basis. This has proved so successful that our "Family Astronomy Series" on Saturday morning has become our most popular single show time.
2) We offered the series to students at non-participating schools through a passive letter sent home with each student. This did not prove effective at all. It is clear that active teacher involvement and promotion is necessary for success.
Although elementary students are excited by space science and astronomy, one severe deficiency in our elementary schools is in current resource books in these areas. For example, one local suburban school had 31 astronomy books in the school library, 87% of which were over 10 years old; only a few were suitable for lower elementary students.

In order to address this need we have established a traveling K-6 Astronomy Library which is loaned to Central Illinois schools for one month at a time.

A team of reviewers evaluated the books received. The team consisted of three classroom teachers, two astronomy professors who also work with elementary age students during summer, and the planetarium director. Books were rated according to reading level, depth of coverage and appropriateness to reading level, clarity, illustrations, accuracy, and organization. The best were then purchased for the library.

A special cart was constructed which is dramatically painted and decorated, able to be wheeled from classroom to classroom, and which can be disassembled into four separate shelves for easy transport in a smaller car.

This availability of exciting, up-to-date, well illustrated astronomy and space science books appropriate to their grade level has served to foster students' interest in and better their understanding of astronomy and space science.

Our most recent innovative outreach program has been our Telescope Loan program.

The goal of this program was to provide area teachers with the necessary training and equipment to conduct star parties at their schools. To accomplish this, the planetarium purchased three telescopes, conducted a workshop in which the teachers received the necessary training and is currently administering a loan program for the telescopes.

The "Dobsonian" style telescope was chosen based on ease of use, price, durability and maximization of aperture. "Telrad" sights were chosen because of their simplicity of use.

A workshop for participating teachers was held over four Wednesday evenings in September 1989. There were five components to the workshop:

1) Locating constellations, planets and deep sky objects;
2) Using computer almanacs;
3) Principles of telescope operation;
4) A guide to conducting school star parties; and
5) Practical use of the telescope.

The first four elements were conducted in the planetarium before sunset, and the telescope practicum was held outside on the Museum grounds, with a star party as the final session held at the observatory of the Peoria Astronomical Society.

We found that the planetarium was an effective environment in which to teach the location of "invisible" deep sky objects, and that the transfer to the real sky was easy with a small amount of practice. This transfer was greatly facilitated by the use of the "Telrad" sight.

We prepared a list of "Star Party Favorites," based on monthly charts and lists from "Exploring the Sky Tonight" by George Reed. The items on these monthly lists are perfect for teaching to the motivated beginner. We also provided participants with a "Star Party Observation Record Sheet" and a list of "tips for holding star parties."

Each telescope resided at a school for 5-6 weeks, with 18 schools participating. A lottery was used to determine the allocation of months. Participating teachers were expected to conduct one or more evening star parties at his or her school during the time that they had the telescope. During the day, the telescope was used for instruction in the use of a telescope, sunspot, and lunar observations. The star parties had the added benefit of involving the parents, since invariably they attended as well.

At Lakeview Museum Planetarium, our goal is to excite as many people as possible to the wonders of our universe. In order to introduce those not in our regular audience to the planetarium, outreach strategies such as these have become an important part of our total program.
PUBLIC OBSERVATORY OPERATION

Jon U. Bell and John Hare

ABSTRACT

John Hare, Director of the Bishop Planetarium and Observatory in Bradenton, Florida, and Jon U. Bell, Director of the Virginia Living Museum's Abbitt Observatory and Planetarium, operate facilities that have active, ambitious public programming. Together they will help participants develop an outline for effective operation of a public observatory, from equipment, solar observing, video CCD systems, staffing and budgeting, to star parties and media events.

INTRODUCTION

The session began as workshop conductors, John Hare and Jon U. Bell, introduced themselves and their observatories. Then each participant spoke about their own facilities.

Jon U. Bell: Abbitt Observatory, Virginia Living Museum, Newport News, Virginia, USA. C14 telescope, 2 CB telescopes, assorted small telescopes, Daystar H-alpha filter for solar observing. Open every sunny day for safe guided views of the sun. Open on clear Thursday nights for moon, planets, stars and a few deep-sky objects. Open during special sky events, such as eclipses and comet apparitions. Full-time staff of 3; 23 volunteers, trained by the Planetarium staff.

John Hare: Bishop Planetarium, Bradenton, Florida, USA 12 and a half foot Ash dome, 6" Astrophysics refractor with Byers 5B German equatorial mount, Daystar H-alpha filter, Panasonic WV-5000 CCD camera and half inch home VHS recorder. Daily solar, night viewing on Fridays and Saturdays - lunar, planetary, some deep-sky. Primarily public and groups. Strongest visitation is solar on Saturday mornings. Solar sessions (very hot in Florida) are usually given by a staff-trained volunteer, night viewing provided by staff. Planning on replacing Panasonic with GBC video enhancer processor system.

Keith Johnson: Fleischmann Planetarium, Reno, Nevada, USA. Telescope with solar filters. Keith reported that his facility, situated near the bright casino lights of Reno, has its share of light pollution problems, but that they aren't as bad as might be thought - this because many of the marquees are built to attract customers, not create glare.

Forrest Pearson: Starlab Planetarium, Chippewa Falls, Wisconsin, USA. C-Ultima 8 telescope. His facility is operated through the Cooperative Educational Service, and has associated with the Hobbs Observatory, which offers public sessions. 24" Newtonian and CCD system, along with smaller scopes and classroom facilities. Forrest expressed great interest in getting information on observatory educational techniques.

Irvin Bassett: Summerhays Planetarium, Provo, Utah, USA. C14 Telescope and observation deck, CB and an old Questar. No solar filters, but plans to get them in the near future. Irvin was looking for ideas for promotion and advertising of observing programs.

Jim Manning: Taylor Planetarium, Bozeman, Montana, USA. Jim reported they currently have an "open air" observatory, a 13" Dobsonian and a 10" Meade that they roll out on the front lawn at the Museum of the Rockies. He also does sky interpretation for participants of the museum's Dino Camp in western Montana. Jim was interested in finding out about other observing programs, and methods for getting equipment donations. He also wanted information on forming an astronomy club, as there are none in his region. Short summer nights at 46 degrees north make this season's sky interpretation a problem.

Dave Hostetter: Natural History Museum Planetarium, Lafayette, Louisiana, USA. 10" reflector, CB, two 6" reflectors and small refractors. Dave wants to build an observatory away from bright town lights. Public visiting is good, but he also expressed interest in getting school groups to participate - looking for equipment and ideas.

Hans Lundstrom: Kosmorama Space Theater, Futures Museum, Borlange, SWEDEN. Hans reported that the museum has just been given a 9" reflector, and that they plan to build an observatory on top of the Galaxen Center, where it will be housed along with an 11" reflector. Plans also call for a coelostat to collect and transmit solar images. He's concerned with observatory accessibility (e.g. elevator for the elderly). CCD systems, image processing and heliostats. Outreach programs are being done.

Derrick Pitts: Fels Planetarium, Philadelphia, Pennsylvania, USA. 24" Newtonian reflector, 10" Zeiss reflector (built in the early '30's - Derrick says it's the finest instrument he's ever worked with in 12 years of observing). H-alpha filter and assorted smaller instruments. The Franklin Institute provides daily solar viewing, as well as Philadelphia nighttime views of the moon, planets, etc. They also provide video to the media and public. Their biggest problem is working with an unskilled staff made
available through the Institute. He wanted ideas for setting up a training program. Another problem is that the 24" is seldom used - it has a few unmanageable idiosyncrasies. They are looking to upgrade their facility and make the night sky more accessible.

Eva Hans; South Tyneside College Planetarium, South Shields, Tyne and Wear, England, UK. 16" Newtonian and a 7" refractor. Public programs aren't too successful, perhaps due to the Planetarium's 55 degree N latitude, excessive cloudiness and a nasty seagull problem. They like to use the top of the observatory roof for nesting, and don't like being disturbed. Eva was also looking for cost-effective observing techniques.

Alan Davenport; University of Maine Planetarium, Orono, Maine, USA. 8" Alvan Clarke and assorted smaller refractors, reflectors. Situated at 45 degrees North, Alan's facility also suffers from short summer nights. The facility does programming for the University students, but Alan wants to develop more public programming. He wanted information on equipment funding and staff development, as well as training techniques, ccds and heliostats.

Jan-Erik Solheim; Tromso, NORWAY. 20 inch reflector (with a polar axis built especially for the facility's 70 degree N location), 2 CB's mounted on the Institute's roof, Questar for road shows. Obviously they do a lot of solar observations in the summer, but just about zero nighttime viewing at that time. Inclement weather is a problem in the winter, and scheduling is troublesome. They provide a lot of slide shows, as well as many sky interpretation sessions of aurora displays. Jan-Erik reported that despite constant exposure to beautiful aurorae, many folk there still are unaware of the science behind them. He's interested in ccds, especially in their applications for large audiences.

York H. Clamann; Jones Planetarium, Abilene, Texas, USA. York reported that while they have no observatory complex, they do provide slide shows, planetariums and many sky interpretation sessions. He was interested in hearing the group discussion of ideas related to observatory operation and techniques.

Per Sievsind; Boverbru, NORWAY. 10" reflector, smaller refractor. Associated with an astronomy club that is building an observatory (they are putting on a lottery to raise money for its construction - they've reached almost 70% of the 60,000 Kroners needed.)

THE OUTLINE

After introductions, Jon Bell and John Hare presented an outline of ideas, which the group discussed at length. Here are some of their comments on the outline topics:

1. Why should you operate an observatory for the public?
   - promote a greater understanding of the sky, the universe, and astronomy; help generate support for the work that astronomers do; provide an educational experience; provide entertainment; improve observational skills in the lay public; serve as a clearinghouse of information on astronomy; give people a frame of reference; bring the skies "down to earth"; teach patience and a sense of time.

2. What goes into an observatory?
   - telescopes, dome, observable sky, recording equipment: wv, ccd/video system, strip chart recorder, photometer, spectrograph, photographic equipment, sidereal clock, an astronomer/sky interpreter
     a. what does an observatory do?
     - is open to the community for guided tours of the sky on a regular basis; sky interpretation; all of the things mentioned in #1.
     b. are you a research observatory that does public programming on the side, or a public observatory that does little or no research?
        - We think of ourselves as public sky interpreters but public considers us as researchers who are taking time out from their work to wear the astronomer's hat. We're popularizers/communicators. This is not necessarily a bad thing and can be used to our advantage (e.g. the media considers us to be a well-informed source.)
     c. location: urban versus rural (advantages, disadvantages)
        - Light pollution in an urban setting is bad, but not an insurmountable problem. In fact, a rural setting may be too remote for easy public access. The ideal setting would have a reasonably dark sky (able to capture M13, M31, M42, M56, etc.) and fairly easy access. Or possibly combine an urban observatory and urban sky interpretation with remote star parties. We all feel that there are things we could do that would alleviate the light pollution in our area.
     d. who is your audience?
        - Anyone who turns on a light! A more detailed breakdown includes elementary students (brought to our facility by adults) a small number of high school students, college students (especially for college affiliated observatories), families - very strong attendance here, the elderly and handicapped, other special audiences, special interest groups such as astronomy clubs, but also youth groups, scouts, dance parties and socials, corporate parties, rotary and other service organizations, radio promotion audiences, special sky event audiences, cranks and crackpots.
     e. community's astronomy clearinghouse of information
        - The astronomy resource person, whoever that is on your staff, is budgeted for and is on tap to talk to the public,
the media, walk-ins, and provide some kind of telephone service (24 hour recorded message, live sky interpreter during regular business hours, etc.)

f. hours of operation

Weekends in particular, and also immediately following a planetarium show to help make the connection between the simulated sky and the real sky. Operation is also set up according to ephemeral events, seasonal light/dark patterns, and according to a parent institution's hours of operation. Planetariums at high latitudes offer planetarium shows based on this fact - some facilities don't offer summer constellation shows because it never gets dark in the summer. People who live near the equator reap the benefit of being able to operate on a regular schedule, which is useful in promoting the facility and observing times. Many of us have to contend with the added insult of delayed observing in summer due to Daylight Savings Time ("Darkness Wasting Time," according to Dave Hostetter. People at high latitudes sometimes get very annoyed.

g. staff:
telescope operators, crowd control/security person, technician, maintenance/custodial, astronomy resource person/interpreter, ticket vendor/sales, p.r. person, secretary, phone receptionist, administrator, board of trustees.

h. charges admission:

comments ranged from "people value what they pay for" to "people may feel 'gyped'" to "people surprised if not charged" to "it is good to sometimes offer free viewing, especially during big sky events."

At this point in the outline discussion, we found ourselves rapidly approaching our time limit. Because so many in the group had expressed an interest in ccd systems, and since John Hare had brought along quite a bit of material on this subject, put together by George Fleenor of his staff, we devoted the rest of the session to this topic. The remainder of the outline was not discussed (except for the very last item), but is printed here to provide the reader with a complete framework of the scope of the workshop's intent.

Video as it applies to the public observatory is a relatively recent technology that promises to have a major impact in communicating the wonders of the skies to large audiences. It also offers the capability of recording phenomena for later use.

The principle is quite simple. A video camera is used in place of the human eye. The resulting image that is captured can be viewed in real time, recorded on video tape, processed and enhanced by additional equipment, or various combinations of the above.

Video monitors can display the images for the public at various remote locations. At the Bishop Planetarium the images can be shown on the planetarium dome utilizing our video projector. This is especially useful during the daytime when solar images (using our Daystar H-alpha filter) are used for visiting school groups.

Affordable video systems for astronomical purposes are a result of the continuing development of CCD cameras (charged coupled device). These cameras are very sensitive (requires little light to capture an image) and are very compact and light (ideal for attaching to a telescope).

CCD cameras alone are available for less than $1000 (U.S. dollars) while complete imaging systems including camera, computer, monitor, and image processing hardware & software can run in excess of $10,000.

George Fleenor of the Bishop Planetarium has compiled a list of CCD cameras and complete imaging systems. To receive a copy contact George Fleenor at:

Bishop Planetarium
201 10th Street West
Bradenton, FL 34205 USA
(813)-746-4132

Additional reference's detailing the Adler Planetarium's Doane Observatory, which was a pioneer in the use of video, are available in Sky & Telescope magazine and the Planetarian.
3. Solar Observations
   a. safety for your staff and your audiences
   b. projection techniques
   c. direct viewing through a filter - no telescope
   d. telescope filters
      i. mylar
      ii. white light
      iii. Hα

4. Dealing with your administration/board
   a. keeping them informed
   b. engaging their support

5. Public Relations/Promotion
   a. Interpreter’s priority list of objects
      i. bright to faint objects
      ii. viewing windows - early setting, late rising
      iii. sky interpretation while waiting to look
   b. taking advantage of ephemeral opportunities
      i. comets
      ii. meteor showers
      iii. eclipses
      iv. flares
      v. oppositions
      vi. satellites
      vii. aurorae
   c. media: newspaper, magazine, tv and radio
      i. features and interviews
      ii. news releases
      iii. psa’s
      iv. paid advertising
      v. observatory generated programs, columns, etc.
      vi. telephone information services
      vii. developing media contacts

6. Star Parties

7. Working with volunteers/astronomy clubs
   a. developing volunteers through public contacts
   b. teenagers/gifted and talented
   c. putting astronomy clubs on your side

8. Special Audiences - what do you do?
   a. deaf
   b. blind
   c. wheelchairs
   d. elderly
   e. learning disabled
   f. other

9. Planetarium programming support
   a. multimedia intro program outside observatory
   b. planetarium shows tied in to seasonal changes
   c. p.l.t.m. shows on ephemeral events
   d. p.l.t.m. sky interpretation on cloudy nights

10. Communication, Cooperation between Observatories
    a. information, news
    b. techniques
    c. symbiosis: swaps, coordinated releases.

Jon Bell took a few moments at the end of the session to explain one way in which planetariums can work together. For the past couple of years, Bell’s facility and Hare’s have worked together in the area of solar flare observations. Both facilities have strengths and weaknesses. Virginia’s strength is a large staff of volunteers who make almost constant real-time solar monitoring possible. Its weakness is that it has no video hookups for public relations work. Florida has a video system, but not enough staff to make it possible to keep a constant watch on the sun. Whenever a solar flare erupts, Bell calls George Fleenor at the Bishop Planetarium, who turns on the video recording system, and captures the event on tape. He then sends a copy of the tape to Bell. Both facilities are then able to provide good coverage of the flare event to the media and public in their respective communities.

HANDOUTS

“Skylights” column on skywatching
Adler article from Planterian on video in observatory
news articles based on observatory events
BEYOND THE DOME - ASTRONOMY OUTREACH PROGRAMS

Lorna Q. Waddell-Kremer

ABSTRACT

This paper discusses the planetarium education outreach program offered jointly by Strasenburgh Planetarium of the Rochester Museum and Science Center and Monroe #2-Orleans BOCES. This outreach program serves students and teachers in the greater Rochester region of New York, in the United States. In addition to the school programs and special presentations offered at Strasenburgh Planetarium, the BOCES program also includes lecture presentations, STARBLAB presentations, use of the Spitz A3P planetarium located at the State University of New York, College at Brockport, evening stargazing parties and teacher workshops. Materials developed by the Lawrence Hall of Science, University of California at Berkeley through a National Science Foundation Grant are also used.

INTRODUCTION

"In the midst of the garden, between two cascades, rose an oval salon three hundred feet in diameter, whose azure vault was sown thickly with golden stars which represented all the constellations and the planets, each in its true place. And this vault turned, like the sky, by power of machines as invisible as those which direct celestial movements." (Voltaire, 1768.) The 91.4 meter dome described in this romantic vision is over three times the diameter of the largest planetarium dome registered with IPS: The Myazaki Museum Planetarium in Japan, which is 27.0 meters in diameter. The fixed stars in the globe's interior moved as the globe rotated on its axis, driven by water power. This 17th. century wonder held an audience of ten, who were able to see the constellation patterns by the light of two oil lamps. In 1715 the globe was presented to Peter the Great as a gift. Patrick Moore contends that it is currently on exhibit in Leningrad. (Moore, 1966.)

Humankind's fascination with the the stars is probably older than civilization. Planetariums capture the wonder of the night sky for modern stargazers; the BOCES Planetarium Service extends the excitement and educational value of the planetarium beyond the dome. The partnership between the BOCES 2 Planetarium Service and Strasenburgh Planetarium of the Rochester Museum and Science Center is over twenty years old. Both the Planetarium Service and Strasenburgh Planetarium continue to offer new and exciting presentations on a continual basis.

ZAP!, for example, was one of the most dramatic presentations offered at Strasenburgh Planetarium in recent years. In this theater production, the persona of Nicola Tesla brought the thrill of one million volts of alternating current or indoor lightning to delighted audiences for six months. When ZAP!, the Strasenburgh presentations ended, ZAP! the BOCES 2 Planetarium Service presentation opened. With the help of a smaller, 60,000 volt Tesla Coil, a 400,000 volt Van De Graaff Generator, aurora tubes, light bulbs, batteries and balloons, school children were given a lesson in electricity which reinforced and complimented the more exotic Strasenburgh presentation. During the Strasenburgh presentation two volunteers were able to participate in each performance: less than 1% of a full-house audience. In contrast, during the BOCES 2 presentation, four to five volunteers were called upon in each classroom. This means that approximately 15% of the student audience was able to take a very active and special part in the learning process. Moreover, the BOCES 2 version of ZAP! will continue to be available to educators and students for years to come because the teaching of electrical theory is an important component of science education.

It is so important, in fact, that the BOCES Planetarium Service was invited to participate in the largest science fair in New York State, and perhaps in the entire United States of America: The St. John Fisher Science Exploration Days held each spring in the Rochester area. This spring both the 200,000 volt and the 1,000,000 volt Tesla Coils built for the Strasenburgh ZAP! performance were taken out of storage. The staff at Strasenburgh and BOCES 2 worked together to put on yet another dramatic science
presentation. Two performances were given, the total attendance was over 800 adolescent students from local New York State schools.

On a more astronomical note, one of 13 other outreach presentations offered by the BOCES service is a classic solar system presentation. During the Strasenburgh solar system program, students are enthralled by the dramatic special effects and large projections of the planets in the star theater. The BOCES presentation also uses quality slide projections in the classroom. Physical limitations are such that only carousel slides are used. For this reason, a sense of drama is created by the use of science demonstrations to teach students about our planetary neighborhood. The majority of the slides used in the classroom are photographs of original artwork created at Strasenburgh. Other excellent sources of visuals used are slides obtained from NASA and the Astronomical Society of the Pacific (ASP). The (ASP) "Worlds in Comparison" series, for example, vividly illustrates size relationships in the solar system. The comparisons between Terrestrial and the Jovian planets were found to be particularly useful. These slides can truly be worth 10,000 words!

Science demonstrations include the use of CO$_2$(s) to illustrate the density of the atmosphere of Venus, and the sublimation of cometary tails and Martian ice caps.

To dramatize presentations in archaeoastronomy, historical costumes are employed. For example, the Stonehenge presentations opens with a blue-faced druidess holding the jaw bone of a cow. She tells the audience: "Behold the orb of the great one rises in the east, light the sacred fires and put the seeds in Gaia's embrace!" The students generally have no idea who Gaia, or the Druids were. During the presentation they learn about the basic astronomy connected with Stonehenge. They also learn some basic archeological information about the people who constructed the three major building phases of Stonehenge. The presentation ends with a look at the Druids, their connection to Stonehenge and to our own culture.

Not all American students are academically oriented. Some students enjoy creating works of art rather than reading from books. For this reason, the BOCES program sponsors an annual Space Art and Literary Contest in cooperation with Strasenburgh Planetarium, RMSC. Adolescent students are invited to submit artwork and brief prose. The artwork and prose are exhibited at Strasenburgh for two weeks. In 1990, the staff at Strasenburgh created an astroscreen show from the students' work. Slides of the artwork and kodaliths of selected quotations were artistically set to music. The astroscreen presentation was enjoyed by the students, their families and the general public for several months. The astroscreen show was a benefit to all parties involved.

Local businesses were solicited for donations which were awarded as prizes in the Art and Literary Show. One of the donations received in 1990 were airline tickets. As a result, five students and two teachers received free flights to Florida to visit the Kennedy Space Center.

One of the goals of the BOCES 2 Planetarium Service is to receive artwork and literature from students in other countries. All IPS member planetarians are invited and encouraged to participate in this effort.

In the summer of 1989, as a result of attending a three week workshop in San Francisco, California, sponsored by the National Science Foundation, the BOCES 2 Planetarium Service received a number of excellent materials for teaching astronomy to pre-adolescent students. Many of these materials were designed to be used in the STARLAB setting. However, a number were also designed to be used in the classroom. For example, the Oobleck workshop was designed to be used in a open, well-lit area. During this exercise, students are given a green mystery substance which they are told comes from outer space. They are taught to use the scientific method to analyze the material and discover its properties.

Several Oobleck workshops were given in 1989 and 1990. In every case, the workshop participants thoroughly enjoyed working with the material. In fact, both adults and children found it difficult to stop playing with Oobleck when they were told the session was ending! This workshop is excellent because it encourages students to think and to experiment. It is also a good vehicle for introducing the topic of alien environments to students. Young students need to realize that there are vast differences in the atmospheres of different planets, for example. Or that liquids can have different densities and viscosities.

The key to the success of the BOCES 2 Planetarium Service, which has been expanding steadily for the past three years, is effective teaching. In America, effective teaching occurs when the instructor provides his or her students with good visual examples of, in this case, science theory. Effective teaching also employs active student participation. American students learn best when they are challenged to give the answers, with the instructors help, rather than being told the answers in lecture fashion. During all BOCES 2 presentation, the students are continually asked questions;
questions that they are capable of answering. In this way, the students' interest level and self-esteem are maintained.

Teaching astronomy under the Strasenburgh dome is complimented by instruction with the State University of Brockport college Spitz A3P planetarium, two STARLABS and, of course, outdoor instruction under Gaea's celestial sphere. This year we purchased a new Celestron C-8 for evening stargazing parties. This coupled with binoculars, an Astroscan telescope and enough current star maps for everyone involved help to make our parties a success. In 1989 a 65 year old women was so impressed with one of our parties that she said: "I have never looked at the stars before, now I will never stop looking." Like the universe, the BOCES 2 Planetarium Service is expanding; our ongoing mission is to ever more effectively bring the excitement of astronomy to the minds of the students we teach.

REFERENCES

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SPACE AND ANIMATED FILM

Erling Eriksson

It is a fact that a fairly high proportion of our children acquire almost as much information about the world via television, film and video as they do at school.

It is therefore essential that we should also impart to children a knowledge of moving images, so that they will understand better what they are seeing.

Within Swedish Educational Broadcasting Corp., several projects are under way with a view to teach children about film. One of these projects is called "All about animated film."

One important aspect of this project is the collaboration between school, a museum, a planetarium and the television company.

I want to invite you to take part in the project "All About Animated Film" with the theme "Astronomy and Space. The aim of the project is to increase knowledge about how to make moving images as well as to increase knowledge about the subject astronomy.

Astronomy and space

School-children make animated film on the theme Astronomy and Space

Utbildningsradion, Kundtjänst, 115 80 STOCKHOLM
DIDACTIC ASPECTS ON HOW TO TEACH SCIENCE BY EXHIBITIONS AND PLANETARIA

Lars Broman, Per Broman and Aadu Ott

Abstract

In order to teach elementary astronomy to students at different school levels as well as to laymen, an interactive methodology to utilize an exhibition and a planetarium was created. Via models and shows in the planetarium, elements of our scientific worldview were visualized. A short course for teacher training was developed in order to give teachers knowledge so they would be able to use a planetarium themselves.

Exhibitions as tools for teaching

We have in our daily didactic work found that it is of value if a large scale scientific environment could be utilized when teaching science. In order to widen the aim of the scientific teaching to include not only formal skills, but engage more aspects of the students creative mind than just the cognitive function, we have built two exhibitions named "Astronomia" and "Albert and Einstein".

Astronomia

"Astronomia" emphasizes the basics of our astronomical concept of the Universe. Our main topic is time measuring. In models we show day and night and the time of the day, the month and the moon faces, the year and the seasons, and finally a "cosmic year".

The cosmic year is symbolized by a slowly rotating galaxy, which is projected using a pinhole technique, giving a nice projected view of the galaxy with some "3D" quality of the image.

The other exhibitions work with models, such as a slowly rotating earth globe equipped with sundials to show time zones (these sundials will be described in detail in an article in the Planeterian), and a moon which slowly travels around an orbit so that the visitor can stand in the middle of the orbit and study the change in faces as the moon travels.

Surrounding the Starlab Planetarium, which is used within the exhibition, there are portraits of the planets, from which we have made a scale model of our solar system in the scale one to ten billions. This model of course does not fit in an exhibition hall, it will have to be placed in the neighborhood from a grapefruit-sized sun in the center of the exhibition. A model of the nearest star, a "tomato" named Proxima Centauri (a red dwarf-star) is also placed in somewhat correct distance from the "sun" in Sweden, namely in Islamabad in Pakistan. This probably makes Astronomia the largest traveling exhibition in the world(!).

Albert and Einstein

In the exhibition "Albert and Einstein" it is possible to follow the development of the personality of a great scientist as well as to study his scientific achievements.

This exhibition is also meant to stress the importance of regarding science in a social context as the scientific achievements lead to changes in the power structure of the world.

The exhibition starts with a presentation of the youth and schooltime of Albert Einstein. Then we meet him in the Patent Office in Bern where he made his world famous theoretical achievements. After that we follow him during the Berlin years. We can sit at a table and study his letter to President Roosevelt which maybe started the race for the atomic bomb. After that we follow Einstein during his Princeton years. We are able to listen to his voice in a telephone and we can get a overview of his life via a video recording.

In a separate part of the exhibition we will find illustrations of Einstein's scientific achievements. In the middle of a room the floor is covered by a picture of "Big Bang" on which a monitor with a slit is placed. Looking into the slit we get a vision of Einstein's curved space. Surrounding this part of the exhibition are items and illustrations which visualize Einstein's laws of unification:
* Unification of particle and wave.
* Unification of time and space.
* Unification of mass and energy.
* Unification of gravitation and geometry.

The visitors can study how balls roll in the curved space and see how gravity is a function of geometry. Einstein himself looks at the visitor from a life-size holographic portrait surrounded by illustrations of his cosmic religion. In another part of the exhibition, some poets give their view on Einstein's Universe.

Throughout the exhibition the fight between classical and modern physics is presented using quotations from Isaac Newton and Albert Einstein, until finally Einstein's last opponent Niels Bohr enters the stage. Surrounding the exhibition stand also some boards filled with aphorismes uttered by Einstein in the form of graffiti.

A possible future for the exhibitions

The two exhibitions have to date been set up in close to a dozen culture houses, museums and schools in western Sweden. In May '91 they will appear together for the first time, constituting the major part of a temporary Science Center in Molndal, a town in the Goteborg metropolitan area. It is hoped that this exhibition will eventually result in a permanent Science Center in Molndal.
A NEW MINIPLANETARIUM FOR CLASSROOMS

Roland Szostak

ABSTRACT

A new technique for overhead projector is presented, which offers great advantages for teaching astronomy in schools and for a good cooperation between planetariums and schools. It shows projected bright stars within the dark background of the sky and allows to study many details of motions in the sky. By working with polarized light and interference effects, the projected sky can be converted into twilight and even into colors. One can also insert illuminated coordinates or movable celestial bodies into the dark sky and study the retrograde motion of a planet.

INTRODUCTION

The motivation for paying a visit to a planetarium is clearly enhanced by the knowledge of the phenomena, which are presented in a planetarium show. Especially for teachers it is desirable to come with well prepared classes, because their pupils will notice more details and understand better certain complex phenomena.

In order to enable the teacher to prepare such a visit in a very effective and attractive way, we developed a new kind of a mini-planetarium, which is extremely cheap and simple to use in the classroom. It displays the stellar sky by means of an overhead projector, generating a surprising touch of the atmosphere to be expected in a planetarium. It shows selected constellations, the diurnal rotation of the stellar sky, the rising and setting of the stars at the local horizon and the seasonal change of the night sky.

In a somewhat advanced version, which works with polarized light, teachers and pupils can simulate, for instance, the break of the dusk and the disappearance of the stars in the twilight. By simple additional means they can even convert the projected sky smoothly into saturated blue or other colors by virtue of interference effects. They can also insert a bright moon and move it through the stellar sky. In the same way they may insert a brilliant planet and guide it on a route typical for its retrograde movement. By simple supplements one can insert illuminated coordinates or the ecliptic line. It is also possible to simulate the scenario of a lunar eclipse, having the additional opportunity of observing the shadow of the earth in space artificially. Star occultations are also available for manipulation.

The great advantage of these presentations is the fact, that the phenomena can be discussed in the classroom with all details and be repeated or modified due to the individual questions of the pupils. This facilitates a proper understanding and enhances the quality of the planned visit. It is expected that this tool for the teachers might be offered by planetaria to schools as a help for preparing the visit with remarkable advantages in understanding and motivation.

A SIMPLE DISPLAY OF STARS BY OVERHEAD PROJECTOR

Usually a visit to a planetarium may be prepared in the classroom by talking about some astronomical phenomena, showing some slides or regarding a star map. The stellar sky may also be discussed by regarding an overhead projection. But due to the techniques, which are available, the stars are presented then as black dots within a white background for the sky at night, which is rather curious and irritating. So we reversed this presentation in a way, that the stars are bright spots on a dark background like in nature. These stars are little holes, made by a needle in a cardboard, which is put quite normally onto an overhead projector. In this case the cardboard prevents all light from being projected except for the light of these stars. This simple technique generates a surprising atmosphere, when it is presented in a perfectly darkened classroom. The auditory will feel being very close to the magnificent spectacle in nature.

In the beginning one may reduce the number of the projected stars to a few popular and well known constellations, for instance the Big Dipper, the Orion, the Cassiopeia and the Lion. This can be done by covering the stellar cardboard with a mask, which is simply a sheet of paper with holes for certain areas, which allow only selected stars to be projected. These few constellations and their relative positions are registered by the eye very easily with high attention. Everybody feels familiar with this view at once.
So the pupils learn how to find certain stars in the night without any difficulty. When the selecting mask has been removed, the eyes recognize the constellations easily among all the other stars. Tests with pupils, even down to an age of below 10 years have shown an excellent memory.

If this stellar cardboard is made as a rotatable disc, one can see how the stellar sky rotates around the polar star due to the rotation of the earth. This stellar disc can be combined with the local horizon as known from planispheres. For this purpose the stellar disc is mounted rotatably with a snap on top of a cardboard, which covers the light-emitting desk of the overhead projector and has a suitable transparent window for the local horizon. Then the auditory can perceive the rising and setting of stars at the horizon. One also learns how the part of the stellar sky, which appears above horizon, changes with the rotation of earth.

One can also make these stars twinkle simply by putting a normal transparent sheet, which has an arbitrary pattern of lines, on top of the stellar disc. These lines randomly cover a part of the stellar holes. When this sheet is moved, the changing occultations induce a fluctuating scenery. This generates the impression of twinkling stars.

As this technique is cheap in all its parts, this new type of display can be afforded by schools. By virtue of low costs it is used in developing countries. So there is a good chance, that really many people can be reached by this presentation of the stellar sky. This star projection in the classroom can provide further successful steps for a good cooperation between schools and planetariums. We have prepared this stellar chart as a kit, which can be made ready for use by the teacher and his pupils. It can be offered to the teachers who make an appointment for a visit to the planetarium. We have stores available for delivering them on request.

AN ADVANCED TECHNIQUE USING POLARIZED LIGHT

The described new display of the stellar sky with bright stars against a dark background provokes some additional insight: Because of the correct presentation of the dark sky for the night the auditory is led to consider the role of the sun. As one full turn of the stellar sky represents a period of 24 hours, the day-time with its bright sky must be included in it. By this it becomes evident to everybody's eyes, that the stars are presently the sky above us also during day-time and that they are not visible only by the fact, that they are submerged into the floodlight of the sun, which is filling the atmosphere. This process, how the stars submerge in the raising floodlight of the atmosphere, can also be displayed on the overhead projector by an advanced version of the new technique. One needs two polarizing filters, each made from a Scotch tape of 30 cm x 30 cm, which cover the light-emitting desk plane of the projector. The one of these sheets contains a pattern of small holes due to the positions of the stars. When these two filters have crossed orientations, the displayed background of the sky will be dark, meanwhile the holes of the stars stay bright. If one now starts turning the second filter, which has no holes, slowly into the orientation of the first filter, then the background of the sky becomes more and more light and the stars fade away in the growing twilight.

On a more advanced level one can also insert moving celestial bodies into the dark background of the sky. Such a celestial body, the moon for instance, appears as a bright object in this projection. It consists of birefringent material, which is inserted between the crossed two polarizing filters. This birefringent material modifies the linearly polarized wave to a circularly polarized wave, whose new component is able to pass through the crossed second filter. Fortunately, Scotch tape is a birefringent material which acts already suitably in this case. If it is fixed on a transparent optically inert carrier, then the bright moon can be moved by hand through the dark sky with its stars. This kind of display again is very surprising to the auditory, because the relations between dark and light parts are reversed to the usual way of the overhead projection. But for the astronomical objects these are just in best agreement with nature.

For fun one may let travel also an illuminated rocket through the sky by this technique. But for teaching it is particularly interesting to insert a planet and to let it travel through the positions of the fixed stars. So its retrograde motion can be simulated by the teacher and by the pupils. This activates the discussion of the ideas of Copernicus in the classroom. All these motions will be shown to the pupils in the planetarium with much more perfection. But by the fact, that they have generated these phenomena with their own hands, their eyes will see more and understand much better during the performance in the planetarium. For a further level of discussion one can also insert illuminated coordinates or other data into the dark background, using the same technique of birefringent material. Similarly one can show illuminated lines, which combine the stars to constellations. In a further extension of the birefringent technique, one can also remove the light of these connecting lines continuously, meanwhile the stars stay bright and the background dark.
One more remark about the simulation of the twilight with polarizing filters as described above: This process can be presented on the overhead even much more impressive by turning this twilight into colors. This can be achieved by inserting a birefringent sheet, which by its suitable thickness generates interference for a certain range of wavelengths. Then the light which passes through these filters looks colored. By turning these filters adequately, the projected dark background of the sky can be changed continuously into a saturated blue and into a light white-blue of the daylight. During this conversion the stars stay unchanged white, they only submerge again in the raising light of the background. These bright stars look very nice in the blue sky, indeed. This presentation is very attractive to the auditory.

By inserting shadowed structures the possibilities of the polarized display can be still further extended. So, for instance, the bright silhouette of the growing moon is only part of the spherical body. Starting again with crossed polarizing filters, only the bright silhouette is visible. It becomes very instructive to the auditory, when by a slight turn of the upper filter the background is converted into a dimmed grey and the shadowed part of the moon becomes also visible. - By the shadowed part of the moon one can also demonstrate the process of star occultations. - In a similar way also the shadow of the earth may be made visible at the sky artificially. This is very helpful for demonstrating the conditions of a lunar eclipse in a new way, by which the auditory becomes aware that during a lunar eclipse one can see the shadow picture of our globe in the sky.

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A TROPICAL SOLAR ECLIPSE: HAWAII 1991
Ken Miller

ABSTRACT

Members of the International Planetarium Society have the opportunity to view the last total eclipse seen from the U.S.A. until 2017. On July 11, 1991 the Big Island of Hawaii will be darkened for up to 4 minutes, 13 seconds. Meteorologists are calling the weather prospects on the west coast of the island the best odds in well over a decade. Add the usual excitement of a total solar eclipse to a tropical vacation in lavish resorts, and this is an eclipse not to be missed!

Planning for the scientific community's activity at the observatories atop Mauna Kea has been under way for several years, and final observing time allocations are now being locked in. University of Hawaii officials who control the summit of Mauna Kea, and officials from the solar observatory on Mauna Loa assure us that no unauthorized traffic will be allowed to the observatory level of either mountain for several days before, and after the eclipse. For those able to stay for a week or so after the eclipse, possibilities exist for commercial tours to the summit, or a chance at renting one of the few 4-wheel drive vehicles on the island which can be self-driven to the summit. We may be able to help those contacting us soon with those arrangements.

Since virtually all the conventional tourist facilities on the Big Island of Hawaii have been booked for over a year, ecliptophiles who are just beginning their quest for more darkness will encounter difficulties in their negotiations with travel agencies. There is, however a ray of hope for the last minute traveler.
In a major series of sponsorship arrangements negotiated over the past year, American Express Travel Service, Aston Hotels and Resorts, Budget Rent A Car, and Hawaiian Airlines have committed over $200,000 to museum exhibits and planetarium educational programs regarding the eclipse. This funding is combined with nearly $150,000 in state funding for the planetarium to teach space and astronomy awareness. More details of the entire ECLIPSE HAWAI'I program can be learned from the accompanying time line.

Our sponsors have also committed their full facilities to serving Bishop Museum in its efforts to package tour activities both for local residents and to our sister institutions around the world. As a result, we have secured a limited number of rooms on the Big Island, and more on on Maui and on the Planetarium's home island of Oahu. The Maui and Oahu packages of hotel room, rental car, and educational activities and materials, also include special charter air transport to the Big Island for the Big Day.

Interested planetarians who wish to come alone or to lead a group from their membership association should contact us immediately. When our packages are exhausted, we will, of course, attempt to steer you to other providers who may still have rooms available. It should be noted that the Big Island's Parker Ranch had planned for a 10,000 site "Tent City." But those plans have fallen through due to public safety concerns, and there are very few camping facilities around the rest of the island.

The altitude of the sun at totality in Hawaii will be 20 degrees. There is a better-than-90% chance of clear skies. Join us in paradise for Totality '91!

An ECLIPSE HAWAI'I Time Line:

July 21, 1990

October 1990
State wide school StarLab and auditorium programs and teacher workshops begin. Our five (5) portable StarLabs visiting six islands should present programs to well over 75,000 children.

February 1991
ECLIPSE HAWAI'I lectures and workshops for the general public begin on Oahu and all neighbor islands. Service club members, individuals, and tourist industry staff will also be given special workshops and materials so that they may become group leaders on "E-Day."

March 16, 1991
Specially produced multi-media ECLIPSE HAWAI'I planetarium program opens to the public. ECLIPSE!, a major 6,000 square foot exhibit on the eclipse, solar science, and astronomy opens in the new Castle Memorial Building. (We welcome your ideas, suggestions, and loaned or rented exhibit elements. Wanna swap for a free hotel?)

July 5-13, 1991
Visitors participate in Bishop Museum eclipse tour packages on Hawaii, Maui, and Oahu. These packages utilize the services of American Express Travel Service Hawaii, Aston Hotels and Resorts, Budget Rent A Car, and Hawaiian Airlines.

July 11, 1991
Bishop Museum Members' "Day Trip to Totality." Approximately 1,000 eclipse-chasing Bishop Museum Association Members and tour package participants from Oahu and Maui are moved to the Big Island by Hawaiian Airlines specially chartered flights.

7:28 AM - July 11, 1991
TOTALITY!
Northern and Southern boundaries and Center Line from US Naval Observatory Circular #170.

Eclipse Hawai’i
Bishop Museum Planetarium
Honolulu, Hawaii.
Several years ago in the music industry, some major synthesizer makers -- all competitors -- got together and agreed upon a method for connecting each other's keyboards and playing them together. The specification they came up with was called MIDI, for Musical Instrument Digital Interface.

Recently in the computer industry, three of the major players -- Lotus, Intel, and Microsoft, got together and agreed upon a method of using a PC's extended memory; they called it the L-I-M EMS 4.0 specification.

Now in the planetarium industry, three companies have combined efforts and agreed upon a method of classifying planetariums by their capabilities to present modern audio-visual planetarium programs. We call it the "L-H-S Level Specification of Planetarium Capabilities Revision 1.0", or simply the "LHS Level Spec". The L-H-S stands for Loch Ness Productions, Joe Hopkins Engineering, and Sky-Skan. The big question is, "Why have we done it?"

First, we wanted to create a detailed description of what we feel is essential for today's planetarium -- no such listing existed. The various levels we've come up with provide a picture of the state-of-the-planetarium-art, and we now have a point of reference.

With such a list prepared, we can now use it ourselves. For Loch Ness Productions, we can classify the shows we produce. For example, our show "More Than Meets The Eye" can easily be shown in a LEVEL 2 planetarium. A show like "The Mars Show" with 300 slides cannot, but it could be a LEVEL 3 show. If our show requires crossfading pans or all-skys, we could recommend it for LEVEL 5 planetaria.

When a new planetarium is being built, the planning committees get various proposals from different vendors, and often don't have a clear picture of all that's involved -- they just know they want a planetarium. With this document in hand, Sky-Skan can now say, "OK, here's what's involved -- what level of planetarium do you want to build?" It's a kind of shopping list.

Joe Hopkins can say, "Looking to upgrade your theater? Let's see what you'll need to move you up to a LEVEL 4: you've got this and this, but you need that and that." It's right here on the list.

You can use the LHS Level Spec yourself -- for support when you go to your administration for money to improve your theater. You can say, "Look, we're not even at a LEVEL 3 because we don't have a zoom or a slew, and we really could use this and this from LEVEL 4. And the planetarium in the next town is already a LEVEL 5 -- we need to get on the stick!" With it all in black and white, it'll be harder to ignore; it can simply plant the idea that there IS an upgrade path for improving your planetarium.
At the very least, it might stimulate YOU to investigate various ways you can enhance your theater's presentations -- and it lets you know what we vendors feel is important for you and your planetarium to have.

The way it works is simple. To see what level your planetarium is at, you start at LEVEL 1, and work your way up. If there's a line item in the Spec that your planetarium doesn't meet, then you're not at that level yet. You can have some of the capabilities of higher levels, but you need to meet ALL the requirements of a particular level to be considered at that level.

LEVEL 1: Virtually every planetarium is at least at this level. However, some feel this is all that should be necessary for a planetarium. Indeed, some proposals for new planetarium constructions have included NO auxiliary equipment, specifying a star projector ONLY. Of course, if our three companies didn't feel differently, we wouldn't be in business.

With the LHS Spec, people interested in building a new facility can see that there's more to a modern-day planetarium than the star projector alone. Maybe 40 years ago that was the case, and certainly effective planetarium demonstrations and star talks can be and are given without auxiliary effects. But it is incumbent on the planetarium of today to do more than the green-arrow shows of 40 years ago; we HAVE progressed and evolved since then.

LEVEL 2 calls for at least 2 slide projectors, and a tape playback system. We don't specify that they be a dissolve pair, although that certainly would be acceptable. We didn't specify a tape format; probably a cassette would be the typical example. There are many Starlabs that are at this level, and there may even be some at LEVEL 3.

LEVEL 3: Now it starts getting interesting. Again, if there's a line item at this level that a planetarium does not have, they are not at this level yet. We feel that a planetarium wishing to present effective audio-visual programs at this level needs AT THE VERY MINIMUM these specified capabilities:

Three dissolve pairs, arrayed Left/Center/Right. Loch Ness customers are already familiar with this format. The screens don't overlap by halves or thirds in multi-image style, because the curvature of the dome prevents that. The dissolve pairs are just aimed roughly adjacent to each other.

A stereo sound system in the theater, fed by multiple sound sources. At a minimum, this means one player for entrance music, and a deck for the show tape. Stereo is mandatory -- if you have a monaural sound system, you are living in the 50's; probably the 7-year-olds in your audience have more sophisticated sound systems than you do -- they certainly hear better sound on their Walkmans than they will in your planetarium.

You should have the basic tools of the trade for creating motion -- a zoom and a slewing mirror. Creative people might even aim the zoom at the slew. At any rate, both are as basic as the green arrow.

You need the ability to project at least a partial panorama; whether it be one dedicated projector with a wide-angle lens or several, this tool is essential for setting scenes in a planetarium.

You need to have the capability for showing animated moving special-effects -- a comet, meteors, an orrery, rotating planets and galaxies -- the "stuff" of space. Note that you DON'T have to have all incandescent special effects: a video projector and special effects from a tape or videodisc can qualify for "having the capability"; Sky-Skan will be happy to sell you their special effects in either form.

You need have a facility to mount and opaque slides. Without specifically dictating it, this implies having at least a light table, Wess glass mounts, and opaquin fluid with a paint brush.

And you need to be able to dub a tape, since at the very least, you have to make an insurance copy of your show tape masters. This implies more than one tape deck, and while you could plug the cables from one to the other to meet the Spec, you'll probably want a mixer and additional audio equipment as well. While we don't specify that here, it is specified in LEVEL 4.

LEVEL 4: Now here's where we actually take a stand that might be considered controversial. We feel that if you're going to present a modern audio-visual planetarium show to today's audiences effectively, your theater needs to have epicentric or uni-directional seating.

You need an audio system that synchronizes your slide projectors and effects with your show tape. We're not specifying which system to use, and you might still run zooms, the star projector, etc., manually; but, some projectors are controlled from the tape.

By specifying a "multi-channel, multi-speaker professional-quality sound system", we've left it open to interpretation. Obviously, stereo sound takes two channels; and to synchronize to tape, you'll need a third channel to store the automation data. By specifying "professional-quality", that will pretty much rule out cassettes as the primary sound source.

You have more than one zoom, and more than one slew, and the ability to project a full horizon panorama, or as much as your tilted-dome will allow.

Video projectors have been here for a number of years; it's time to jump on the bandwagon if you haven't already.

In LEVEL 3, you just had to have special effects capability; here at LEVEL 4 we say you should have multiple special effects, including rotators, revealers, polarizers, and the ability to do whole-dome effects: snow, clouds, etc.

If you're doing audio-visual programs, you need an audio studio, and we've specified some of the basic equipment to have.

Your visual studio has a camera and copy stand (which implies lights, a meter, filters, etc.). You need to be able to duplicate slides, either on your copy stand, or with a device like a Repronor or Illumtran. And you need to be able to mask and align slides. This implies that you have the capability to develop Kodakith and LPD-4 film, which im
Digital audio is here to stay, and the analog tape recorders of the 60's and 70's are going to be replaced by DAT's, and digital multi-track recorders.

You might wish to add the interactive audience-polling systems and programs currently in use in several planetarium theaters to provide your audiences with more reasons to return to your theater more often.

There was a proposal made a while back for "standardization", with details down to what format tape to use and even what channels to record the narration on. That is NOT what the LHS Level Spec is about. You can see it's general enough to allow for various configurations, yet still includes the basic categories of what we feel is important to have.

This is best part -- if you disagree with the levels we've devised, or don't like where your planetarium falls in the LHS Spec, no problem. You can always ignore it. No one's going to force you to accept our plan. Our companies have already come up with it, and we're giving it to you. It's done -- here it is.

Of course, we hope that you WILL accept it and that you'll find it useful. If it becomes a kind of "industry standard", or at least an accepted guideline that everyone will know and refer to, great - so much the better. Our three companies are going to use it, and we hope you will too.

**LEVEL 6: If a planetarium is going to do video and do it right, then it will need to equip a video studio: a camera, a switcher, editing VCRs and an edit controller, time-base corrector, monitors, effects units, etc.**

Computers are used to generate artwork and graphics, and you'll have a film recorder to transfer the computer image directly to film.

---

**L-H-S LEVEL SPECIFICATION OF PLANETARIUM CAPABILITIES REVISION 1.0**

**LOCH NESS PRODUCTIONS - JOE HOPKINS ENGINEERING - SKY-SKAN, INC.**

---

<table>
<thead>
<tr>
<th>LEVEL 1:</th>
<th>LEVEL 4:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star projector</td>
<td>LEVEL 2 capabilities, plus:</td>
</tr>
<tr>
<td></td>
<td>Epicentric or unidirectional seating *</td>
</tr>
<tr>
<td></td>
<td>3-, 4-, or more projectors in precision</td>
</tr>
<tr>
<td></td>
<td>aligned stackers with multi-image animation capability</td>
</tr>
<tr>
<td></td>
<td>Soundtrack-synchronized automation system</td>
</tr>
<tr>
<td></td>
<td>controlling multi-image projectors and effects</td>
</tr>
<tr>
<td></td>
<td>Multi-speaker, multi-channel</td>
</tr>
<tr>
<td></td>
<td>professional-quality sound system</td>
</tr>
<tr>
<td></td>
<td>Multi motorized zooms</td>
</tr>
<tr>
<td></td>
<td>Digital audio is here to stay, and the analog tape recorders</td>
</tr>
<tr>
<td></td>
<td>of the 60's and 70's are going to be replaced by DAT's, and digital</td>
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<td>You might wish to add the interactive audience-polling systems and</td>
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<td></td>
<td>programs currently in use in several planetarium theaters to provide</td>
</tr>
<tr>
<td></td>
<td>your audiences with more reasons to return to your theater more often.</td>
</tr>
</tbody>
</table>

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**LEVEL 2:**

- 3 80/tray slide projectors
- Tape playback sound system

**LEVEL 3:**

- 3 Ektographic (or equivalent) dissolve pairs, arrayed
  - Left/Center/Right
- Stereo sound system in theater, fed by multiple sound sources
  - 1 motorized zoom
  - 1 motorized zoom
- Partial panorama
- Special effects capability:
  - comet
  - meteors
  - orrery
  - rotating planets,
  - rotating galaxy, etc.

**LEVEL 4:**

- Sound studio:
  - Microphones
  - Tape recorders
  - Amplifier/speakers
  - Notes reduction system as needed
  - ultrasound equipment
  - Music/sound effects libraries

**LEVEL 5:**

- tape recorders of the 60's and 70's are going to be replaced by DAT's, and digital multi-track recorders.
- You might wish to add the interactive audience-polling systems and programs currently in use in several planetarium theaters to provide your audiences with more reasons to return to your theater more often.
- There was a proposal made a while back for "standardization", with details down to what format tape to use and even what channels to record the narration on. That is NOT what the LHS Level Spec is about. You can see it's general enough to allow for various configurations, yet still includes the basic categories of what we feel is important to have.
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---

**LEVEL 6:**

- Video studio: camera, switcher, editing
  - VCR's and edit controller, monitors, time-base corrector, effects units, etc.
- Computer-generated art/graphics system, film recorder, etc.
- Digital audio system

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**Interactive programming capability**

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The stronger the eruption or the display is, the farther to the south the activity is pushed. (point out the coast of Norway and the contours which of the midnight sun and the northern lights. I remember the big sunspot maximum. Where are the Northern Lights located? Much warmer than in Borlange, Chicago and New York. The Northern Lights or the Aurora Borealis is the most spectacular natural phenomenon on earth. Where are the Northern Lights located? Most people know that we have to go north to find the northern lights. What is not equally well known is that if you go far enough north the activity of the northern lights will decrease instead of increase. The Northern lights are located in a narrow belt, called the auroral oval. This picture, which probably many of you have seen before, shows the auroral oval on the top of the earth. And in this picture we can see a fraction of the oval out in the Atlantic ocean west of Norway. If you wonder how much energy is given off in a Northern Lights display, have a look at this picture. The brighter parts of this picture is the light from a major Northern Lights display. The stronger the eruption, or the display is, the farther to the south the activity zone is pushed. (point out the coast of Norway and the contours of Europe) We can clearly see that there is more light here than from all of the cities of Europe together.

I am born in Tromsø, and I have been living in Tromsø most of my life. A true child of the midnight sun and the northern lights. I remember the big sunspot maximum, which also is a Northern Lights maximum, back in the late fifties. I was laying on my back in the snow looking at some magnificent auroral displays. Being an everyday phenomenon in northern Norway, they still fascinate me. When you have a major display, it often starts with a band or two sitting low on the horizon, calmly. Then it curls, and the curl floats along the band. A new band is lit, and it moves upward. And another band. Waves and curls are moving along the bands. You can see that they are composed of rays as the bands are getting broader. Then within a few minutes the sky seems to explode. There is a dramatic change in the events up in the atmosphere. An auroral substorm has started. Rays of light shoot down rapidly, forming bands like draperies which spread all over the sky. And they really remind us of draperies or curtains which are flickering in the wind. The main color of the curtains are green, but they are decorated with a violet and a red trimming at the lower and upper ends. The draperies and bands are moving and undulating vigorously all over the sky. Disappearing and forming all over again by new rays shooting down from space. Above our heads we can see rays going out in all directions; forming what is called an auroral corona. This is the peak in the show that nature has set up for us. After ten to twenty minutes the activity decreases again. The substorm is over. The bands are spread out, getting weaker, and finally dissolved in a diffuse light all over the sky. And if we observe the sky carefully, we can see the last part of the northern lights display like clouds being switched on and off as though by an electric light switch every five- to ten seconds. It is now between twelve and two o’clock in the morning, and the nature’s lightshow is over. This description is a part of our show about arctic light. The sequence of events in an auroral display is partly due to the fact that the auroral oval sits there on the top of the earth. And as the earth rotates, different places moves under the oval, and then out again. So when we see the Northern Lights in Tromsø low on the horizon early in the evening, we are at the edge of the oval, on our way under it. Tromsø happens to be exactly in the middle of the most active part of the northern lights zone. We like to think of our selfs as the Northern Lights capital of the world, and I think we have good reason to do that. Let me add that Tromsø people are not very famous for being modest.

Well, back to the northern lights. The reason why I am standing here is to present to you a better way of making northern lights displays on your dome. What I have said so far has been in order to emphasize the fact that we have the advantages of all the geographical and scientific conditions to produce and provide other planetariums with material for projecting northern lights in their domes. If you have one of these magnificent auroral special effect projectors, don’t throw it away.--- Find something to use it for. But if you want to make good auroral displays, think of us.

I have brought with me a couple of slide series to show you what I mean. These series of slides are taken for animation. It is impossible to show you the animation during this presentation, but I am quite sure that being creative planetarium workers, you will have no problems imagining what it will be like when you have big projections in a complete and smooth dissolve. The pictures here are taken with interwalls of 6 - 8 seconds. When they are shown, you will get the best impression if you use 3 or 4 projectors. Starting a new frame every 1.25 seconds if you are using 4 projectors. Give it a fade to maximum and down again within four seconds, and you will have one second to change frame.

A presentation of the auroras done in this way, will give what is impossible to obtain in any other way. I am thinking about the fine structures in the displays, for instance the rays of light. This is because we can use fast film and short exposure times. I am then talking about exposure times of about one second. Done on film or with special effects you have no way of getting the right ray structure. So in many ways animated slideseries give an impression close to what you can see in nature as possible. (Explain what we see in the series of slides. An maybe in some single slides too)

When I attended my first summer institute about planetarium work, one of the things I learned from one of the teachers was “don’t miss the boat” Meaning that if a special astronomical event is taking place, present it in your planetarium while the topic is hot. Of course you know that the sunspots, and the solar activity follows an
eleven year cycle. More solar activity creates more solar wind. And the northern lights are caused by particles from the solar wind. The next two years are expected maximum period of northern lights activity. And as a matter of fact this is not just another maximum. The sun is probably more active than it has been in three hundred years. Causing global heating and magnificent auroras. Last winter in Tromsø we had weaker or stronger northern lights approximately five out of seven days a week. I have heard about auroras way down in Spain, and in New Orleans during the last year. The memories from the auroras in the fifties are very strong, but all measurements tell that what we can see now is even more spectacular. The active sun and the northern lights

Don't miss the boat

Contact me if you want to know more about our program.

---

**USAGE PATTERNS FOR AN INTERACTIVE VIDEODISC SYSTEM**

Irvin G. Bassett

**ABSTRACT**

An interactive videodisc system is set up as a window display in one of the corridors of the Eyring Science Center. The system uses the "Laser Write" program from Optical Data Corporation with some modifications. The major modification is the addition of a counting loop in the program that counts the number of times a viewer presses a key on the console. The number of key presses over a period of time yields information on the amount of activity or interest a program generates. Subjects presented include astronomy, physical science, geology, and weather. The location of the display can be moved between the main lobby and a small hallway between classrooms. The study compares activity (interest) as subject matter and location are varied. The results of the study should lead to improved programming and optimum utilization of the system as a teaching tool.

**DESCRIPTION OF SYSTEM**

The videodisc system consists of a Pioneer LDV 4000 videodisc player output to a Sony KV 1966 Television set. The system is controlled by an Apple II+ computer with some modifications. Interfacing between the computer and the videodisc is done using the VAI-II system from Video Vision Associates (now Optical Data Corporation). The entire system is installed in a display case with a glass front. The television monitor presents the pictures while the computer monitor displays the captions or descriptive information. A numeric keypad has been added to the Apple II+ computer. The user has access to this keypad for input selections. The rest of the system is behind the glass of the display case, out of reach and out of sight, except for the two monitors. A timing system has also been installed, so that if the system is idle for two hours without any keys being pressed, the disk player and the monitors will shut down. Pressing any key will set the system in operation again. The computer power is left on continuously.
Software for the computer control is from the "Laser Write" program by Video Vision (Optical Data Corp.), with some modifications. The first modification involves rewriting the input codes so they can be read from the keypad instead of the computer keyboard. At any time, if the user selects the number 9 key the system resets to the beginning of the presentation. In addition, a subroutine was added that counts the number of times the keypad is activated by a user. Each time a key is pressed, the event counter is incremented by one. There is a normal two to four second delay while the next picture and caption are being brought up on the screen. During that time, the counter is not active. This prevents erroneous data from being entered by someone tapping rapidly on the keypad. Periodically the system operator opens the case and calls for a tally from the keyboard. The computer displays the number of events that have occurred since the last reset and again resets the counter to zero.

Each presentation is recorded on a separate floppy computer disk. The system operator can select the program he wishes to present and insert that disk in the computer. With the proper videodisc in the player the presentation is ready to go. Usually a particular presentation is run for a week at a time. If a class is studying a subject, and there is a video presentation covering that subject, it is a simple matter to load that presentation on the system. A variety of options are available for the presentations. One can simply go from one picture and caption or movie clip to the next or branch from one section of the program to another. Programs can be written to ask for true-false responses or for multiple choice answers. Later versions of the software also allow for "fill in the blanks" responses. The system is an excellent teaching tool for presenting information, interactive teaching, giving examinations, and surveying students' learning. The presentations in this study are all straightforward, with the user simply bringing up the next image or movie clip, and occasionally choosing which branch of the presentation he or she wishes to view next.

LOCATION PREFERENCE

We had a choice of two locations in the Science Center where we could install the system. The first was a display window in a side hallway between two classrooms. The lighting was good for the video display in that there was no direct sunlight and the pictures show up well and catch the eye. It is one of the main hallways, but a large fraction of the traffic in the building does not pass that way. The second choice was a similar display window in the front lobby of the building, next to the Foucault pendulum. More people pass through the lobby so the display could be more visible there.

The disadvantage of the lobby location is the lighting. Daylight, and especially the afternoon sun, in the lobby create a glare on the glass case and on the front of the television tube. Although more people pass through the lobby than the smaller hallway, many of them pass considerable distance from the display and are not made aware of it. The video display is in competition with the Foucault pendulum and five other display cases in the lobby. The first part of this study seeks to determine which location brings in the most viewers.

The system was set up in one location and then the other for a period of two to three weeks each. Four different presentations were used at each location. The number of "events" (number of times any key was pressed) was tallied each day. The average number of events per day are listed in Table 1 for the four presentations. Although the difference is not large, there is a 16% increase in activity in the hallway location. After the results are known, it is easy to find reasons to explain them. Observations of the actions of people passing by the display, and conversations with some of them lead to the conclusion that although fewer people pass by the hallway location, they are more attracted to the pictures there than they are in the larger area of the lobby. As people pass through the lobby, their attention seems to be more on their destination than looking around to see what is available.

Table 1. Comparison of activity between lobby and hallway.

<table>
<thead>
<tr>
<th>Title of presentation</th>
<th>Average num. of events/day</th>
<th>% diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hall</td>
<td>Lobby</td>
</tr>
<tr>
<td>The Electromagnetic Spectrum</td>
<td>301</td>
<td>214</td>
</tr>
<tr>
<td>Stellar Evolution</td>
<td>593</td>
<td>559</td>
</tr>
<tr>
<td>Utah from Space (Landsat)</td>
<td>461</td>
<td>431</td>
</tr>
<tr>
<td>Weather Movie Clips</td>
<td>392</td>
<td>342</td>
</tr>
<tr>
<td></td>
<td>Average percent:</td>
<td>16</td>
</tr>
</tbody>
</table>

It was noticed that when a presentation first appeared in either location, there would be an initial surge of interest, followed by a noticeable decrease in activity. Changing presentations at least weekly helps greatly in maintaining a high level of interest.
Sixteen different programs were used in the study. There is a wide variety of topics and a wide range in the complexity of the presentations. The programs are listed in Table 2 by subject classification. Usually a program would run for one week, from Monday through Sunday. The tally of events was counted daily and an average figured over the total number of days the program ran. There are a number of factors that can each influence the activity at the display. Some of these could not be controlled, such as visiting groups in the building on some days and fewer on others. An instructor for a particular course might notice that the current display pertains to what he is teaching and advertise it to his students. A holiday weekend would decrease the number of people in the building. Often there will be several people together watching the display. This would constitute an increase in viewership without any increase in the count of activity.

Table 2. Titles by subject classification.

<table>
<thead>
<tr>
<th>Astronomy</th>
<th>Average num. of events/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Astronomy</td>
<td></td>
</tr>
<tr>
<td>The Electromagnetic Spectrum</td>
<td>301-214</td>
</tr>
<tr>
<td>Coordinate Systems</td>
<td>572</td>
</tr>
<tr>
<td>History of Astronomy</td>
<td>300</td>
</tr>
<tr>
<td>Telescopes</td>
<td>589</td>
</tr>
<tr>
<td>The Solar System</td>
<td></td>
</tr>
<tr>
<td>Moons of the Solar System</td>
<td>328</td>
</tr>
<tr>
<td>Apollo on the Moon</td>
<td>1017</td>
</tr>
<tr>
<td>Jupiter &amp; Saturn</td>
<td></td>
</tr>
<tr>
<td>Uranus, Neptune, &amp; Pluto</td>
<td>218</td>
</tr>
<tr>
<td>Stars and Galaxies</td>
<td></td>
</tr>
<tr>
<td>Stellar Evolution</td>
<td>593-559</td>
</tr>
<tr>
<td>The Milky Way</td>
<td>497</td>
</tr>
<tr>
<td>Galaxies &amp; Nebulae, Review &amp; Quiz</td>
<td>480</td>
</tr>
</tbody>
</table>

| Earth Science                  |                           |
| Meteorology                    |                           |
| Clouds                         | 723                       |
| The Earth's Atmosphere         | 417                       |
| Weather Movie Clips            | 392-342                   |
| Geology                        |                           |
| Glaciers                       | 384                       |
| Plate Tectonics                | 571                       |
| Utah from Space (Landsat)      | 461-431                   |

Table 3 lists the programs in order of the average number of events per day, with the most active program at the top. There is no clear-cut preference by subject or category.

Table 3. Titles by decreasing average number of events/day

<table>
<thead>
<tr>
<th>Title</th>
<th>Average number of events/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apollo on the Moon</td>
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</tr>
<tr>
<td>Clouds</td>
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<tr>
<td>Uranus, Neptune, &amp; Pluto</td>
<td>218</td>
</tr>
</tbody>
</table>

It would appear that there are stronger influences than subject matter determining the activity. Some of these were mentioned above. Some factors that can be considered and measured include the complexity of each program, the average length of captions, the total amount of "events" in each presentation, what kind of advertising a presentation gets, and others. This is an ongoing study, only in its beginning stages. As more data are collected we will be able to average out some of the outside influences and determine the relative importance of the controllable factors.

The general interest in the display has demonstrated that it is an excellent teaching tool. There are many options to be explored. We are working to improve the presentations and hope to obtain more definitive answers to the question of relative subject interest.
SUPERCOMPUTER ANIMATIONS FOR PLANETARIUM SHOWS, EXHIBITS, LECTURES, ETC.: A POTPOURRI OF WHAT IS AVAILABLE

William A. Gutsch

ABSTRACT

Over the past several years, computer and supercomputer power has increased dramatically, allowing for the creation of dynamic new visualizations of astronomical, meteorological, and geophysical phenomena.

TEXT

The introduction of computer graphics to research and educational programs has had monumental impact on their effectiveness at helping scientists and students better visualize and understand a broad spectrum of physical and mathematical relationships.

Many such computer and supercomputer products have been produced by our colleagues at numerous facilities in university and research laboratory settings and commonly exist in the form of videotape, 1.44Mb floppy disk or CD ROM. With video making ever-greater inroads into planetarium theaters, exhibit halls, and classrooms, such simulations offer a valuable additional educational and program resource to us all, yet, by and large, many of these products are not widely known to members of the planetarium community.

Some products represent a visualization of imaging or numerical data from spacecraft specially-treated to reveal surface or atmospheric detail or show how such detail changes as a function of time. Examples include:

- newly-processed images of Jupiter via Voyager
- time-lapsed variations in global ozone column densities
- time-lapsed global temperature anomalies, and
- time-lapsed infrared geostationary weather satellite imagery.

Other visualizations represent three-dimensional spacial representations of objects and include:

- the movements of the earth and moon around the sun, and
- the large-scale structure of galactic superclusters.

Still other products represent visualizations from mathematical modeling and include:

- the formation and evolution of severe storms
- the formation of "jet-like" phenomena in quasars, black holes, and active galactic nuclei
- colliding neutron stars, and
- interacting galaxies.

The author is presenting this paper (with a sample of products created within the United States shown at IPS '90 in Borlange) for a variety of reasons. First, to show the membership examples of some relatively recent products which many might not have seen before. Second, by so doing, to briefly illustrate only a fraction of the dramatic and useful materials which are being created. Third, to request that other interested members, especially those from outside the United States, research the existence of other such products and, fourth, to offer to serve, along with a few other such members, as representatives of IPS for the purpose of acquiring the rights from individual scientists, universities, and laboratories to make useful copies of the best of these materials for distribution on tape (or even laser disc) to IPS members for use in their institutions.
PLANETARIUM INSTRUCTION WITH A HELIOSTAT or "LET THE SUNSHINE INTO YOUR DOME"

Eloise W. Koonce

ABSTRACT

The heliostat is incorporated into the overall Planetarium program of the Richardson Independent School District. The installation includes a TRAX Instruments M35 computer controlled heliostat with solar white light, Hydrogen-Alpha, solar prominence telescopes and a spectroscope. In coordination with the Planetarium projector the heliostat has greatly enhanced programming and provided a new dimension of effectiveness to the curriculum.

LOCATION

The Richardson Independent School District is a public suburban school district located in Dallas and Richardson, Texas, U.S.A. It includes approximately 32,000 students enrolled in fifty schools.

The Planetarium serves students in grades one through twelve in regular and summer terms. Students are bussed to the Planetarium for multi-disciplinary presentations in the areas of science, math, language arts and social science.

EQUIPMENT

The addition of a TRAX M35 Heliostat in 1980 added greatly to the scope of the curriculum. Originally the Planetarium had included a star chamber utilizing a Spitz 512 projector. But in 1980 an audio-visual classroom was added to the facility. With the classroom also came the addition of the heliostat.

The installation includes a vertical model heliostat that uses mirrors to redirect the beam of sunlight through the hole in the roof, down into the solar laboratory located in the hallway. There are three telescope benches; the lower one is the solar white light, the middle bench is the Hydrogen-Alpha, and the upper bench simulates a corona graph allowing study of the sun's atmosphere.

The beam of sunlight may also be redirected into the audio-visual classroom for additional displays. A two-foot square screen provides close up views of sunspots and the opportunity to observe and study the solar white light image on an amplified basis. The spectroscope projects the solar spectrum on a rear view screen.

CURRICULUM

In the lower grades the heliostat is utilized in a variety of formats for instruction. Specific uses range from viewing the sun on a particular day as an addition to the regular planetarium lesson to studying the solar image as an integral portion of the lesson. For example, in the sixth grade, (that would be an eleven year old student), one laboratory topic is "Time Zones." Study of the sun's image is a part of the classroom portion of the lesson and the heliostat also ties the concept of changing time zones back into the student's daily living. By displaying the heliostat computer status screen and noting the different time zones displayed, the student is given the example of Greenwich Mean Time then asked to compare that to local time. This provides a practical application used on a daily basis by society. The solar spectrum is used extensively for spectroscopy studies with physics, chemistry and eighth grade earth science students in a variety of laboratory applications.

The heliostat is also used for a more obvious purpose, that of viewing solar eclipses. During the May 30, 1984 Annular Solar Eclipse the classroom was opened to the public. A television tape of the changing solar image was produced and it became the basis for a television program still in use by the Richardson Schools Instructional Television Center.

CURRENT AND FUTURE DEVELOPMENT

In 1989 a television camera was added to the Hydrogen-Alpha bench enabling us to receive a television image from the Hydrogen-Alpha telescope. This added dimension allows us to record the activity occurring on the solar surface over a designated length of time. Students will now be able to follow the progress and development of sunspots across the disk, time the sun's rotation, and study other features; such as, filaments, flares and prominences. This is an area of continuing exploration and we feel it has great potential in the future for educational use.
SUMMARY

We find that children have an avid interest in the sun and it has become a highlight of their visit to the Planetarium from one year to the next. They come in the front door asking questions. "What's the sun doing today?" "May I see it?" "Why is it white?" "How many prominences are there?" "Where are they?"

We look forward to finding new ways to incorporate the heliostat into our curriculum in the future.

NEW EQUIPMENT AT MADRID PLANETARIUM

Asuncion Sanchez and Tono Bernedo

Madrid Planetarium opened on the 29th of September, 1986. That is, we will be shortly celebrating the first four years of running, in which there has been a great response by the public all over Spain.

In the past month of June, we exceeded the figure of a million visitors.

When we started working in the Planetarium project, 4 years and 8 months ago, the City Council had already bought the initial equipment from Carl Zeiss Jena, including:

- Star projector, Spacemaster RPF-DP3, with automatic control, with a dome 17.5 metres diameter.
- 48 slide projectors, mod. Kodak 2010, two sets of 12 for panoramas, and 2 sets of 12 to allow projecting anywhere in the dome, controled by Electrosonic ESC with an Apple II computer.
- Sound system included a 4 track tape deck: 2 for music and effects, 1 for text, 1 for time code to synchronize the 3 computers which run the Star projector, Slides and sound. The sound control is an Omni-Q by Commercial Electronics, controlling sound levels for 3 channels and direction of 2 channels to 20 loudspeakers, 16 on the horizon and 4 at the zenith.

We completed this system with 20 amplifiers and loudspeakers of 200 watts of power each, equalizers and a Tascam mix-deck for 8 channels.

For the opening show we bought 6 special effect projectors by Sky Skan controled from the Zeiss console.

We started working with this equipment, and though we had a great success and it was good enough for a start, we always had in mind that we still had a lot of work to do before we could have an acceptable equipment.

During 1987 and 88, we installed around 30 different effects, some from Sky Skan, some from Edmonton Space Sciences Centre, built by Alexander Sokolowsky, and some built in our own workshop.

Apart from effects like rotating planets, comets, meteorites, Galaxies, Supernova, Black hole, etc, we have now two 15 to 1 zooms with automated two axis slaws; Two slide rotators, two Vorteses projecting on the whole dome, and which people really like.

All the controls and automation for the effects and projectors have been designed and built by our technicians Pablo Duran and Toño Bernedo.
During the past year we have been working on the installation and adjusting of the All-Sky system, which today is a reality. We installed two sets of 6 projectors with 35 mm Navitar lenses, which include off-axis correction lenses. We changed the slide control system by Electrosonic BSC, running in a PC-XT.

While working on that, we developed the method to produce images for this system, starting from photographs or artwork.

We want to thank the help of Jeff Chester from Albert Einstein Planetarium. Following his advice, we have been able to do very good photographic All-Skies.

We use a 16mm Sigma lens on the camera, mounted on a specially designed and built mounting, which allows the camera to turn around the optical axis. We found, after many tests, that for our dome, we get the best results tilting the camera an angle of 35 degrees from the horizon when taking the photo.

To do artwork All-Skies, Nicolas Cardiel, a student of astrophysics and regular collaborator of the Planetarium, created a computer program which obtains the appropriate grids for every application. The program simulates the view that a person, placed in the middle of the dome, will have of a particular object.

The key points of the object are projected on the dome, giving the right distortion.

Then, knowing the exact position of the projectors in the dome, distance to the centre, height to the horizon, and tilt, we project the previously distorted object in the focal plane of each projector and we obtain the individual grids.

Due to the fact that we do not have much more space to install new projectors, and taking into account the wide range of possibilities opened by video, we will buy this year:

- 3 Video projectors Sony 1041Q
- 4 Disc Drivers Pioneer 8000 NTSC
- 1 Tape player Sony 3/4" - PAL
- 1 Spice-Nutmeg Control by Sky Skan

This equipment will be installed in the centre of the dome, in a module, presently being designed by Toño Benedito, and where we will place some slide projectors with mirrors to cover the zenith area to avoid distortion.

Besides the show room, we have two areas where we set different exhibitions along the year.

By the end of 1991 we would like to have some exhibits and interactive videos, but this would depend on the Council decision.

We would also want to build the appropriate tower to install the coelostat which the City Council bought from Carl Zeiss Jena along with the planetarium.

Within it there would be an exhibition area dedicated to the Sun. This has been a claim which we present the Council every year, but decision does not depend on us.

As it is, we are quite happy with the City Council of Madrid, for having made a considerable effort of investment every year to ensure the good technical capabilities in the Planetarium of Madrid.

EXHIBITION TECHNIQUES

Per Broman, Lars Broman and Kjell Engström

The role of an exhibition is usually manyfold: To give aesthetic experiences, to provide comprehensive information, to create emotions, etc. The didactic role is frequently, even if not always, the primary one: The intention with the exhibition is to teach something to the exhibitee - some knowledge, an attitude, a way of reasoning - or awaken her interest in a particular subject. The workshop dealt primarily with the didactic aspects of exhibitions and how exhibits can constitute learning environments.

A successful exhibition must be catching and attractive. This can be done in a multitude of ways. Given the space and the money, total realistic environments are effective. Modern museum techniques let the exhibitee use many senses, interact with the exhibits, perform experiments, be an active user of the museum. This multi-sense approach has a strong didactic value as well - learning by discovery, invention and experience usually works quite well.

The museum director, the exhibit builder and the docent must all be educators. A common saying goes "a picture says more than a thousand words", but it can be equally true that "an exhibit says more than a thousand pictures". The exhibitor is in the position to use so many more dimensions than the picture's two: Depth, motion, sound, texture, embracing, etc.

However, in making exhibitions teach, the creators must use not only creative museum technology, but also build educative situations into the exhibits. Some thirty participants in two workshops discussed how this may be achieved, starting with the following two examples, fetched from Broman Planetarium's Astronoma exhibition:

A ball, strongly lit from one direction and slowly orbiting the exhibitee's head will in a minute convey an absolute understanding of how the phases of the moon are created. A slowly rotating earth globe with tiny sundials placed at different longitudes will, if lit from one direction, let the exhibitee discover and consequently fully understand why the time is different at different places on the earth.
INTERACTION BETWEEN PLANETARIANS AND ASTRONOMERS

Hans Jorn Fogh Olsen

Abstracts

For the time being, I have the opportunity to stand with one foot among astronomers and one foot among planetarians.

For many years I was only among astronomers but also taking interest in teaching of astronomy, but I never heard about planetarians.

When the International Astronomical Union met in Baltimore in 1986 I asked in commission 46 dealing with Teaching of Astronomy, why they did so little for planetarians, although the planetarians have contact with several million people every year. I am sure they realized that there could be done a lot more in this area and they agreed to set up a working group under commission 46 of IAU when they were convinced that there was a need for such a working group. I was asked to present a proposal for such a working group at the next IAU general assembly in 1991.

For that purpose I need your help during this workshop in one or two ways:

1. Specifications of what you need from astronomers to carry out work as planetarians. I want to join you if you want good images taken with large telescopes or even space telescopes. But how do we handle such requests?

2. You may have been a planetarian for such long time that you know a lot of how to handle such problems. In that case I am among a large group of newcomers which should be grateful to share such information with you.

I am looking forward to a fruitful discussion and to have your endorsement to continue working in this area.
Introduction

The following participated in the workshop:
Michey Schmidt, George Brown, Ramatosh Sakar, Agnes Acker, Torbjørn Urke, Per Kr. Sivemind, Donald Bloom, Christopher Juren, Mona Engberg, Silva Fernkvist, Laura Yule, Roland Szostak, Rodger Thomsen and myself.

Discussion

After presenting the concept for this workshop as given in the abstract we discussed the problem that usually the planetarians were looking for "information from astronomers", but it was more difficult to see how astronomers could get something in return. Although it was difficult to find any subject where astronomers could gain directly from planetarians, it was obvious that a widespread information about astronomy was most valuable for astronomers as support for keeping a high level of astronomical research.

Information from astronomers particularly about the latest news was greatly appreciated, but usually difficult to obtain. A few participants could tell about very good examples where they profited from personal contact with research astronomers. It was highly recommended to establish such contacts if possible, but it was also understood, that information about such contacts had to be kept among few persons.

When discussing more organized information services, each participant could provide the group with proposals. Organizations like NASA, ESA and ESO among others provide well established information services also including material free of charge. It was nevertheless the general opinion that it could often be difficult to obtain exactly what was needed without having a personal contact.

Conclusion

On this background the workshop decided to recommend IPS to bring more information about this subject to members and if possible to get a closer collaboration with IAU commission 46, Teaching of Astronomy.

If accepted by IPS the following members volunteered to work on this: Michey Schmidt, George Brown, Ramatosh Sarkar, Agnes Acker, Hans Jørn Fogh Olsen.

PROGRAMMING AND MARKETING FOR PUBLIC PLANETARIUMS

Donald S. Hall

A participatory workshop designed and presented by Donald S. Hall, Director of the Strasenburgh Planetarium, Rochester, NY, USA, assisted by Joel Smith, Rochester, NY, USA.

During this three hour workshop participants in both small and large groups created and exchanged ideas about shows and their promotion in public planetariums. During pre-registration, 22 conference registrants signed up for this workshop, of whom 20 were actually present at the Conference. Of these 20, seven did participate in the workshop, with another 11 conference attendees making a last minute decision to join, for a total of 18. They were:

Christine Brunello, Chapel Hill, NC, USA
Austin Guiles, Chapel Hill, NC, USA
John Mosley, Los Angeles, CA, USA
Wayne Narron, Stockton, CA, USA
Larry Schindler, Boston, MA, USA
Leif Sorensen, Solbjerg, Denmark
Steven Zavalney, Amarillo, TX, USA
Deiter Herrmann, Berlin, Germany
Johan Gijsbergs, Genk, Belgium
Dennis Milbrandt, Calgary, Alberta, Canada
Ammiel Najer, Hollywood, CA, USA
Mike Dufil, Burbank, CA, USA
Suzane Andersen, Copenhagen, Denmark
Steen Ivesen, Copenhagen, Denmark
Julian Ravest, Godalming, England
Von Del Chamberlain, Salt Lake City, UT, USA
Steve Smith, Arlington, VA, USA.
Jack Johnson, Tucson, AZ, USA
The room was set up with movable chairs arranged in a circle. The participants were invited to mingle with each other, introducing themselves to at least three people that they did not know, or know well. They then paired off, each person taking five minutes to describe to the other his or her own planetarium, with special emphasis on programs. Following this introduction, the pairs reassembled in a circle and were invited to summarize what each told her partner. The participants were told to listen to the comments of others noting who was saying what. Here are some of the comments:

John Mosley expressed a need for bi-lingual programs.

Lief Sorensen was concerned about more money for programs, noting that in Europe the tax laws are different than in the USA where private donors have a tax advantage.

Jack Johnson felt that laser shows were both a blessing and a curse.

Johan Gijsenbergs felt the need to begin planning the marketing of shows for his as yet unopened planetarium.

Dieter Herrmann expressed concern about two major planetariums in one city, now that the Berlin Wall is down.

Dennis Milbrandt urged incorporation of new technology into shows.

Steve Smith advocated targeting different audiences with specific kinds of shows.

Julian Ravest talked about tying-in school programs with the area schools' science curriculum.

Wayne Narron felt his planetarium was invisible to the general public, since it is located on a college campus.

Larry Schindler explained his use of outreach astronomy programs in the museum.

Christine Brunello stated that better publicity for school shows produced an immediate increase in school attendance while Austin Guiles expressed concern about declining public attendance.

Steen Ivesen and Suzane Andersen both complained about too many people in public shows.

These comments were not so much on programming as they were on concerns. The large group was then invited to form into small groups, of three of four members, based on the comments of one person which were of special interest to the others. The groups discussed their common interests for 20 minutes. Following this, the group re-formed into a large circle and members reported on what they heard in their small groups that had meaning to them. Here are some of the ideas and comments:

In an attempt to spread student visitation more evenly over the school year and cut down on the spring crush, teachers were encouraged to "book early" to make sure they would be able to attend.

Science drama, with both humor and audience participation, can be a very successful format and can subsidize other aspects of planetarium operation.

A "marketing approach" instead of "product approach" is useful in providing programs that the public, through surveys, has indicated that it wants to see.

An aggressive marketing approach, rather than simply announcing a program schedule for school programs, pays off.

"Selling" your ticket sellers on your programs is an effective way of increasing ticket sales.

After a brief stretch break the group shifted focus to attendance as one quick measure of success. In general, the planetariums represented had increased attendance, during a recent 12 month period, ranging from slight to 20%. Tucson reported flat attendance. East Berlin reported a decrease of 30%, probably caused by a diversion of East Berliners' attention to more earthly pursuits. Attendance in Boston was unknown, while Copenhagen was greatly exceeding its projections with 450,000 people in the first eight months!

The members of the group were then invited to pair up again with
someone unknown, and to share ideas about shows that brought in a larger than usual number of people. These show ideas were then shared with the large group under general headings such as Public Shows, Children/Family Shows, Special Shows. Ideas for Public Shows ranged to marking the 500th anniversary of Columbus's voyage in 1492 to a program about how the start of Ramadan (the ninth month of the Islamic calendar) is determined. Ideas for Children/Family shows including live storytelling about the nighttime sky and the need to include time for follow-up discussion, with questions and answers, after children's shows.

In large group discussion, the participants discussed the benefits of live performance, including possible audience participation, perhaps in the form of direct questions to the audience, but with the cautionary note that skilled lecturers were needed to handle this. If theatre is being done, then experienced actors were considered a must.

The idea of audience response devices was raised with wide ranging opinions. Participants felt that they permitted audience participation, but that they could be overdone, giving a show based on audience response, a lack of continuity. If the responders are used to answer questions, one participant felt that a person responding incorrectly needed information about why his answer was incorrect.

Workshop participants also noted that FM microphones could free the narrator from having to be in the console so that she could walk among the members of the audience. This roving narrator could be made even more flexible through computer controlled sequences that were initiated by a wireless start button, such as a garage door opener.

The final part of the three hour workshop was spent first in pairs, then in a large group discussing successful advertising and promotion. One participant mentioned that when a TV station was listed as a joint sponsor of a planetarium show, the money the planetarium spent on paid advertising with that station bought not only the usual amount of time, but also a substantial amount of additional time at no extra charge. The use of small astronomical events such as an elongation of Venus and carefully worded media releases on astrological events could be effective ways of getting media attention. Controversy, such as the idea that a planetarium might be built on scenic space in a park, or when famous people attend, can get media attention.

The workshop concluded with my remarks that we are bright and creative professionals. We can be grateful that we have the freedom to be creative and the gift of imagination, because if we can imagine it, we can achieve it. But, we must imagine it first. We need to let our imaginations roam and be the best planetarians that we can.
THE STAR SHOP - COSMIC COMMERCIALISM AT ITS BEST

James A. Horn

ABSTRACT

Many Planetariums have gift counters, which help to provide additional funds for the Planetarium's primary mission of astronomy education. How well they succeed, however, can be a somewhat unfathomable formula for the unprepared educator, as we found out in a recent study of our operation. The study's results, and the subsequent refurbishing of the area has proved a delightful success story. How this success can apply to your operation is the story of "The Star Shop."

Greetings from the fifth oldest Planetarium in the United States, now completing our fortieth anniversary year...and what a year it has been. The return of the original Mercury astronauts to their former celestial training center started a year of activities, special shows, and hard work that resulted in an increase of 50% over our average attendance for the past five years, 132,050 paid admissions to programs, including over 34,000 to our fortieth anniversary production "The Legacy." All in all, it's been a great year.

As a prelude to this exciting year we had decided it was time to rework our aging ticket office. This old lobby is very beautiful and traditional, with vaulted ceilings and leather padded Planetarium doors. In a building expansion in 1975 the lobby had been increased in size, but the location of the ticket counter had never been changed to make best use of the added space. The traffic flow was poor, and the patrons had to cross the center of the lobby to purchase tickets. As in all Planetariums, it had been decided in 1953 that, as long as you were selling tickets, you may as well sell a pennant with a picture of the Planetarium instrument on it as well, and so began the inevitable "gift counter." The profits from such a counter, $75 per year, would be returned to the Planetarium to help offset the cost of the person selling the tickets, who would, of course, act as both ticket seller and gift seller. Thus the start of most gift sales at most museums and Planetariums around the country. As the years progressed, we added items to the behind-the-counter stock and sales grew, reaching somewhat of a plateau in the early 80's of between $25,000 and $30,000 per year. What a deal - money for free from a staff that was already there to serve another purpose.

In 1985-86, the year of Halley's Comet, attendance at the Planetarium rose dramatically, as it did at most of our institutions. This increased traffic at our shows also resulted in increased sales at the gift counter and caused a logistical nightmare in trying to serve those people. That, the coming fortieth anniversary, and the condition of our aging ticket lobby counter convinced us to look at the possibility of renovation. An old southern adage says "If you always do what you've always done, you'll always get what you've always got." In that spirit we started to design a new and bigger sales counter to be located in an area of the lobby that would promote better traffic flow, allow us to increase the size of the existing counter, and thus increase sales. We were, as usual, wrong.

Fortunately, it occurred to us to ask a few questions about what we were doing and why. We called in the head of the University's Student Stores operation to consult on our counter. He said, "Gentlemen, the concept of self-service was established 35 years ago and is the cornerstone of all current retail trade, particularly where the traffic is there for another reason. Redesign your project and apply the 'point of sale' concept to it, and you may be surprised." Our first reaction, of course, was to ignore him and do what "we know" to be best. The children would steal us blind, where was our absolute security of the counter with all merchandise behind locked glass enclosures, etc., etc. But what the heck, we'd look.

Our new sales manager Barbara Maddrey and I started an aggressive campaign to show that we were right. We had our eyes opened by concepts that we had never dreamed of. We visited other, more modern, Museum Stores in our area. We went to airport stores and mall specialty shops, talked to their managers about modular design, frontage, lighting differential, slot wall, alcoves, mirror placement, merchandise appeal, and traffic to sales ratios. All of these stores measure their business success on point of sale merchandising techniques. These are techniques that are applied when the potential buyers are coming to your facility for some other reason.

Our new sales manager Barbara Maddrey and I started an aggressive campaign to show that we were right. We had our eyes opened by concepts that we had never dreamed of. We visited other, more modern, Museum Stores in our area. We went to airport stores and mall specialty shops, talked to their managers about modular design, frontage, lighting differential, slot wall, alcoves, mirror placement, merchandise appeal, and traffic to sales ratios. All of these stores measure their business success on point of sale merchandising techniques. These are techniques that are applied when the potential buyers are coming to your facility for some other reason. We were directed to the Museum Store Association, the national organization that promotes museum stores sales and hosts an annual conference where vendors display a tremendous variety of merchandise.
Their literature and publications were very helpful in implementing a plan of action.

 Needless to say, we started over on our design. We re-designed the physical space to accommodate as many of the things we had learned as we could. We opened up the area and minimized the counter space to accommodate ticket sales, cash registers and a few nicer items. We overcame the opposition to openness with a nightly activated motion detecting security system. This allowed us to eliminate walls or closures that were costly and which provided artificial barriers to sales in our limited space. We tried hard to design in keeping with the traditional flavor of our old lobby, using brass fixtures and hardware, but we did not allow this to prevent us from using the modular design techniques that would provide flexibility for displays. After much planning and concern, we started construction in January of 1989.

Construction was provided by our Physical Plant. Snail's pace is their maximum operating speed, and we were off to the races. After almost six months we completed the construction, just in time for our fortieth anniversary opening in June of 1989. We were all pleased with the results, but we had spent just over $40,000, and were all concerned that it would take us five years to recoup that investment. In June of 1989 our gross sales were $11,245, an increase of 62% over the previous June, which in itself was triple the best June we had had in our history. For the year we increased sales 93% over the previous 12 months in our old gift counter space. We have realized an increase of 290% in sales over the past five years, to a total of $158,021 this year. We easily recouped the cost of construction in one year. We were indeed very pleased.

Are we a success? I guess so, the figures look good to us. I keep on wondering what we didn't do or didn't learn that would have made them better. I encourage you to look into how these potential changes could result in increased operating capital for you. Don't be afraid to ask questions, there's likely forty years of marketing history you could be ignoring. Join the Museum Store Association. They can be reached at:

Museum Store Association
501 S. Cherry St., Suite 460
Denver, CO 80222
(303)329-6968

They are a tremendous source of information about design and subsequent sales.

Most importantly, hire a store manager who is not afraid to be an aggressive advocate of increased sales and who is willing to work toward that end. We did; Barbara Maddrey has been the driving force behind most of our success. Give her a call at (919)962-1236; she can help. Finally, return the profits directly to the Planetarium operation; don't let them be siphoned off by your local University stores or your Museum board. If you are like us, you need all you can get. Go for it; take this Cosmic Commercialism to the Bank.
The Boundless Planetarium
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