Advertisements

Do you have anything for sale, or do you want anything (preferably, but not necessarily astronomical)? Advertise here - no charge.

1994 Astrocalendars

Don't forget that you receive a free Astrocalendar as a member of the Astronomy Section. It contains full details of the appearance of the stars and planets month by month, as well as meteor showers, eclipses and other information.

Unfortunately, the 1994 Astrocalendars have been lost in the post. It is feared that they were caught in the Norman Commodore fire before Christmas. A claim has been made, and they should be replaced very shortly. Paid-up members will receive a copy as soon as it is available, hopefully during January.

Sponsors wanted

Each month we have been fortunate in having the production of Sagittarius sponsored. Do you know of a company who would be prepared to sponsor an issue at a cost of £25?

Opinions

Opinions expressed in Sagittarius are those of the authors, and are not necessarily endorsed by the Astronomy Section or La Société Guernesiaise.

Astronomy Section Officers

Section Secretary: Geoff Falla Tel. 724101
Honorary Treasurer: Peter Langford 720649
Education Officer: David Williams 725088

The next newsletter will be published early in March. The deadline for publication materials is 15th February.

La Société Guernesiaise, Candie Gardens, St. Peter Port, Guernsey
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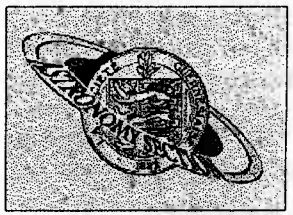
Sagittarius

The Newsletter of the Astronomy Section of La Société Guernesiaise

January/February 1994



Forthcoming events

Annual Business Meeting
Tuesday, 25th January
8.00 pm at the Observatory

Landmarks in Space Research
Tuesday, 22nd February
8.00 pm at the Observatory

Further dates for your diary
Public Star Nights and Telescope Surgery
15th - 18th March

The full programme for 1994 is now available

Inside

Major articles in **bold**

Centre inserts
Taurus - the Bull
January/February star chart

Annual Business Meeting

The Astronomy Section's Annual Business Meeting will be held at **8.00 pm on Tuesday, the 25th January 1994 at the Observatory**. All members are urged to attend this meeting, when a number of important issues will be discussed. The Section Secretary, Geoff Falla, has announced the following agenda:-

Election of Officers

Finances

Observatory:

- **Additional mount**
- **Workshop area**
- **CCD Camera**
- **Solar project**
- **Celestial sphere project**

Public visits to the Observatory

Additional night for observing

Programme for 1994

Any other business

Landmarks in space research

At **8.00 pm on Tuesday, the 22nd February 1994 at the Observatory**, Geoff Falla will describe the story of space research, from the early beginnings to the present day. His talk will be illustrated with colour slides and news reports.

The history of space exploration has long been Geoff's special interest. This should be a comprehensive review, not only of the American programme, but also those of other countries, including Russia's.

Mercury and Pluto

At the November meeting members heard Frank Dowding describe the two smallest planets, Mercury and Pluto - also the closest and farthest planets from the Sun.

He pointed out their similarities - in their sizes, solid surfaces and eccentric orbits. He also described the discovery of Pluto in 1930, and the discovery of Pluto's moon, Charon, in 1978. Pluto is so far away from the Sun (40 times farther than the Earth) that sunlight there would appear only as bright as a bright moonlit night on the Earth.

For extremes of temperature, nothing can beat Mercury, with plus 415°C on the sunlit side and minus 170°C on the dark side. Pluto is colder yet, at minus 230°C.

Frank spoke of the geology of the planets, and theories of their origins, and concluded by showing several slides of both planets.

Quiz and Supper Evening

A small but appreciative group of members attended the annual quiz and supper evening, and enjoyed a good repast washed down by a wide variety of well thought out questions set by Daniel Cave. Some of them may be included in future issues of Sagittarius.

Lunar Eclipse

Unfortunately, the weather got the better of us once again, and the total lunar eclipse of the 29 November was itself eclipsed by the cloud. We shall have to await the next one - in 1996!

Subscriptions now due

Subscriptions to La Société Guernesiaise, and your contributions to the Astronomy Section are now due. Rates for 1994 are:-

	Société	Section
	£	£
Single	11.00	5.00
Double	14.00	5.00
Students	2.50	3.00
OAPs	11.00	3.00

Don't forget that you must be a member of La Société in order to be a Section member. Send your subs to the respective Honorary Treasurers:-

La Société - Betty Caldwell, Treasurer, Le Courtil Tomar, Rue des Près, St. Peter's;

Astronomy Section - Peter Langford, 3 Cameron Place, Upper St. Jacques, St. Peter Port.

The Astronomy Section would be grateful for any contributions over and above the normal rates. We have further equipment needs to increase the scientific and educational aspects of our activities.

Boys Brigade successes

David Williams has been tutoring five boys of the L'Islet Boys Brigade for their Astronomy badge. This included both theoretical and practical sessions, and was concluded by a test. All were successful.

David has prepared a number of hand-out sheets for this course, which are available to other members undertaking similar training. They cover the Moon and its phases, eclipses, the solar system, the constellations, tides, and telescopes.

Brownies see Saturn

On the 10th November 1993, 23 members of the 6th St Martin's Brownies Pack visited the Observatory, with three adult leaders. Fortunately, the sky cleared sufficiently for all of them to see Saturn. Some also saw the Andromeda Galaxy and other objects. Many thanks to those members who came to help with this occasion.

Following their visit we received a colourful thank-you card, adorned with stars and cheerful-looking suns.

With many thanks for an enjoyable evening's star-gazing.

from

All the Brownies of the 6th St. Martin's Pack.

The Sun

"Like a mother she tends to the needs of her children, sustaining them, giving them life and light."

So wrote one of the ancient philosophers, and perhaps more perceptively:

"The creator and destroyer of all life."

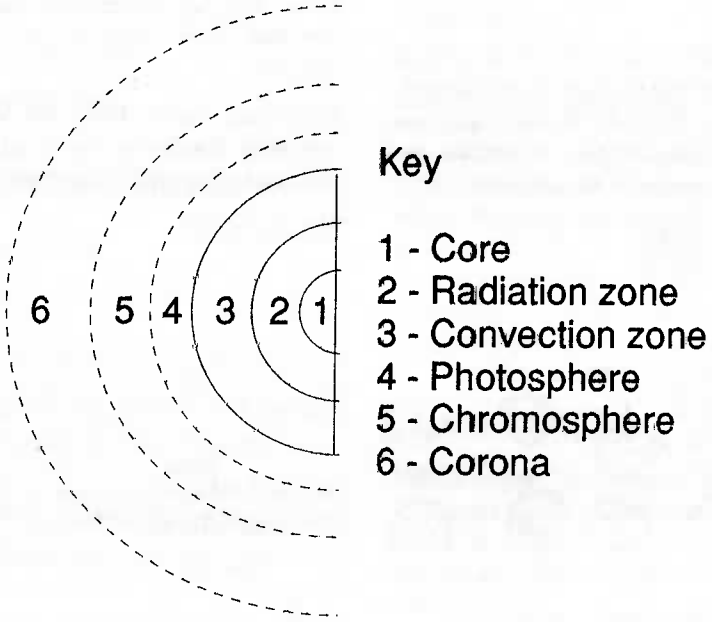
The Sun, as we know, provides us with all the light and heat necessary to sustain life on Earth. It is the centre of the solar system of nine planets, of which we are the third.

Although it appears huge to us, in excess of 1,000,000 km (the Earth, by comparison, is 12,750 km in diameter), it is, on the cosmic scale a medium sized and fairly ordinary star. Thankfully for us, it is also a very stable star. The spectral type based upon the Harvard classification is G2.

Approximately 1,000,000 Earths would fit inside it. It has an apparent magnitude of minus 26.9, and an equatorial rotation period of 25 days. Its velocity is 19 km/sec towards the constellation of Hercules, and of course it shares in the velocity of the Galaxy, which is 272 km/sec.

The Sun is approximately 5,000,000,000 years old, which makes it a middle aged star, and astronomers believe it is approximately at the mid stage of its life. It is a giant nuclear reactor, converting the gas hydrogen into helium at the rate of 4,000,000 tonnes/sec. In so doing it gives out radiation in the form of light, heat and various radio emissions. All the elements found on Earth can be found in the Sun.

Let us delve inside the Sun, using a sectional diagram. »»



A cross-sectional diagram of the Sun

The core temperature is 14,000,000 °C, at a pressure of 2.2 x 10^{11} atmospheres, and, moving out towards the surface, the photosphere temperature is 6,000 °C, the chromosphere is 35,000 °C, and the corona, which is visible so spectacularly at solar eclipses, is 1,000,000 °C.

Of course, other features are visible: the darker (cooler) areas known as sunspots, at 4,000 °C, and from time to time vast solar flares or prominences which erupt from the surface into space outwards to a distance of 625,000 km.

The light generated by the Sun travels through space at 300,000 km/sec, and covers the distance to Earth, 150,000,000 km, in approximately 8½ minutes.

The Sun is indeed the source of all life on Earth, and it continues to sustain our lives. It has been regarded as a god, and worshipped throughout history by many different cultures. This is understandable as, if the Sun shone the crops would grow; if the god was angry then it could destroy the crops, and stop the rain from coming, thereby punishing the people. No wonder they sacrificed their own to appease this great god.

Well, all this is the stuff of myth, legend and ignorance. Our understanding of the Sun continues to improve, but like the ancient sun worshippers, the one factor we share in common is to respect, give thanks and appreciate the importance of the Sun in the continuing story of life on Earth. ¤

David Williams

References:

Sectional drawing of the Sun

The Penguin Book of the Physical World, 1976

The Penguin Book of Astronomy, 1966

The House of the Sun

In the previous article, David Williams mentioned that throughout history, and in many different cultures, the Sun has been worshipped as a god. This reminded me of the legend of "The House of the Sun".

When I lived and worked on the island of Maui, Hawaii, in 1969-70, our satellite tracking station was located on the summit of the dormant volcano Haleakala, with its enormous caldera - large enough to put Guernsey in! Maui was named after a demigod, and the story went that he snared the Sun and made it promise to move more slowly through the sky. (In this he was rather more successful than in his other recorded exploit, when he tried to pull the island of Kauai towards Oahu with a fishing line.) The island of Maui is dominated by the volcano, which the Hawaiians named "Haleakala" meaning House of the Sun.

- and Time of the Moon

Incidentally, the Hawaiians called the Moon "Mahina", and measured time by it, rather than by the Sun. We all know that the month is based on the phases of the Moon, but the Hawaiians went further and used the rising and setting of the Moon to establish the night. They did not calculate days, but nights, and had no concept of hours and minutes.

However, I have a note that some Hawaiians thought of the period of time which we call a day as the time between noon, "when the Sun stood overhead", until midnight "when the fish turn in the Milky Way". I can't fathom the origin of that expression or idea. Can anyone else?

DLC

Exploring, colonising and terraforming Mars

The human colonisation of other worlds is a favourite subject with science fiction writers, but how feasible is this on a planet where life does not already exist?

Mars is the most suitable place in the Solar System for humans to inhabit, after the Earth. The Martian atmosphere is thin (with a surface pressure about 1/125 that of the Earth). Because of its small thermal inertia and low insulating ability, a temperature range between -125°C and 35°C occurs. It is composed mainly of carbon dioxide (95%) with small amounts of nitrogen (3%) and argon (2%). The gravitational field is 37% as strong as Earth's, which is enough to prevent bone decalcification and muscle wastage in humans. Mars possibly has large reserves of water kept in a permafrost layer; surface features suggest that once this water flowed across the planet. Exploration of the Martian surface by the Viking landers showed that the soil is rich in iron oxide and probably contains all the elements needed for human life.

First steps to a new world

A large number of spacecraft have been sent to Mars over the last 30 years, most notably the Mariner 9 and Viking 1 and 2 missions. Large amounts of data have been obtained, but before people can set foot on Mars many questions need to be answered. Questions like:

Does Mars possess a magnetic field?

How active are the volcanoes on Mars?

Mars once had water, where is it today?

What causes the planet's dust storms?

What is the internal structure like?

Mars's thin atmosphere is visible in this image of the planet.

In an attempt to answer some of the questions, NASA launched the $1 billion Mars Observer spacecraft. Sadly, on 21st August 1993, after an 11 month journey the spacecraft fell silent and all attempts to re-establish contact with it failed.

The next launch window to Mars opens in October 1994, and a replacement mission, using spare parts from Mars Observer may be possible. A NASA panel is considering this option. If a second Mars Observer spacecraft is sent in 1994 it won't be alone - the Russians are also launching an ambitious mission to the planet. »»

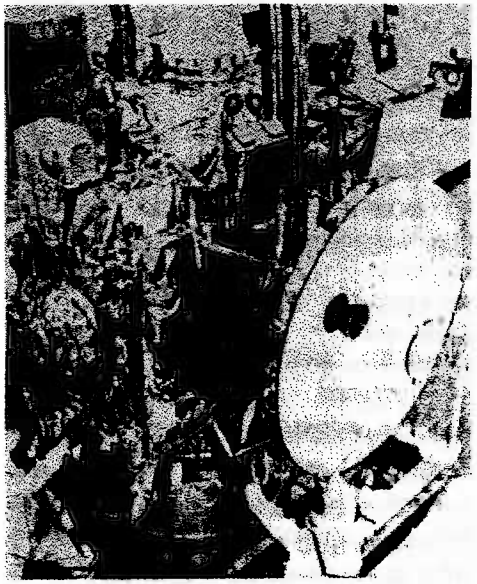
Known as Mars '94/'96, the project will send spacecraft to the planet to arrive in 1995 and 1997. The Mars Observer spacecraft was to have acted as a data relay for both the Mars '94 and '96 missions. The loss may mean a reduction in the amount of data these missions can return.

The Mars '94 probe, an orbiter, will carry two landers and two penetrators to Mars. The orbiter will release the landers and penetrators before reaching Mars's orbit. Once in orbit the craft will begin observations of the planet. Meanwhile the landers and penetrators will be arriving on Mars.

The spherical landers are very robust - they have to be as they will impact the surface with a force 200 times that of Earth's gravity. The large impact is cushioned by air bags. Once they have landed, ingenious petal-like panels will open, righting the landers and exposing their instrument package. The instruments may include a camera, magnetometer, spectrometer and weather monitoring devices.

The penetrators are of novel design. These creations will impact the Martian surface at about 500 kilometres per hour. The bottom part of the device will bury itself deep underground, while the top will just remain above the surface. Instruments inside the penetrator will measure the forces it encounters during the impact in order to determine the density of the Martian soil. After the impact the buried portion will listen for Mars quakes in an attempt to determine the internal structure of the planet. It will also analyse the chemistry of the soil. The exposed end of the penetrator will take images of the immediate area with a camera, and other instruments will record the local weather conditions. The data from the landers and penetrators will be relayed to Earth via the Mars orbiter (it was here that NASA's Mars Observer was to have been of help).

Two years after the launch of Mars '94 the most complex mission yet sent to the red planet will be launched. Mars '96 involves sending a single spacecraft to orbit the planet. Once in orbit the spacecraft will release a large protective aeroshell containing a balloon probe and a surface rover. Initially travelling at 14,000 kilometres per hour, the aeroshell will decelerate its important cargo and protects it against the high temperatures of entry until parachutes can safely operate. Two parachutes will open and drag the balloon probe and rover out of the aeroshell.



NASA's ill-fated Mars Observer before launch

During the descent the balloon will begin to inflate with helium to its 40 metre length. The parachute will detach itself »»

from the balloon 3 kilometres above the ground. It is at this height that the balloon will float for much of its short mission (about one week). Carrying a camera and weather instruments, the balloon will record the Martian climate at this height and take close-up images of the planetary surface during the day. Once the Sun has set, however, the reduced temperature will cause the density of the helium to increase. The balloon will then contract and sink towards the ground. It is here that an instrument filled counterweight (known as the snake) will come into contact with the surface and conduct experiments on the soil (the exact nature of these experiments has yet to be decided). The next morning, the heating of the balloon by the Sun will again cause it to rise, and allow it to continue its aerial photography and other measurements.

The Mars rover, also sent on its way to the surface by parachute, will quickly prepare itself for impact. It will do this by inflating protective air bags around itself. After its cushioned landing, the rover will shed its protective layer and get ready for work.

The rover's major task will be to collect soil samples for analysis and to determine the geology of Mars over a large area. The six wheeled vehicle will use two cameras to provide stereo views of the landscape, and it has an articulated chassis that allows it to better negotiate obstacles. It also has a low centre of gravity, making it very stable - this is achieved by placing much of the rover's equipment inside its conical wheels. A prototype of this vehicle, tested in Death Valley, California, showed the rover to be capable of performing well.

The 1996 launch window may also see the start of an American mission heading for Mars. Known as the MESUR Pathfinder (Mars Environmental SURvey), this mission will be a precursor to a large environmental survey of Mars. If the full MESUR mission is approved then a network of small landers will be dotted around the surface of the planet. The Pathfinder will be one such lander.

The Russian Mars rover on trials in California.

Carrying a panoramic camera and atmospheric monitoring equipment the Pathfinder will be similar to the Russian landers to be launched in 1994. One way in which this mission will be different from the Mars '94 landers, however, is that this lander will carry a small rover along with it. Mounted on the rover will be more equipment, a spectrometer, camera and possibly a manipulator arm. Smaller rovers, known as micro rovers, are also under consideration for inclusion on later MESUR landers.

The whole design of the MESUR mission means that the survey can be carried out quickly and cheaply; the MESUR Pathfinder will only cost $150 million (excluding launch). A saving has been achieved by using simple designs and by sending the spacecraft by direct entry, which means that it does not first go into orbit around Mars before it enters the atmosphere. MESUR forms a part of NASA's Discovery Program. »»

While the Europeans will be collaborating on some of the missions that have been mentioned, ESA does have plans of its own. MARSNET, planned for a 2001/3 launch, is yet another series of Martian landers. Designed to study internal structure, geology, geochemistry, and atmospheric circulation, MARSNET will consist of a network of three landers and one orbiting satellite.

The landers will be sent to Mars on a carrier module that will dispatch the landers to the surface upon reaching Mars's orbit. Aeroshells and parachutes will be used for the descent. The orbiting spacecraft used to carry the landers there may be used as a data relay.

Once a thorough unmanned exploration has been carried out the next step is the manned exploration of Mars (not discussed here). Of the many proposed missions most suggest a small crew being sent to Mars, then returning at the next return launch window. These missions typically enable a one year stay on Mars, with a total mission time of three years.

Genesis of a new world

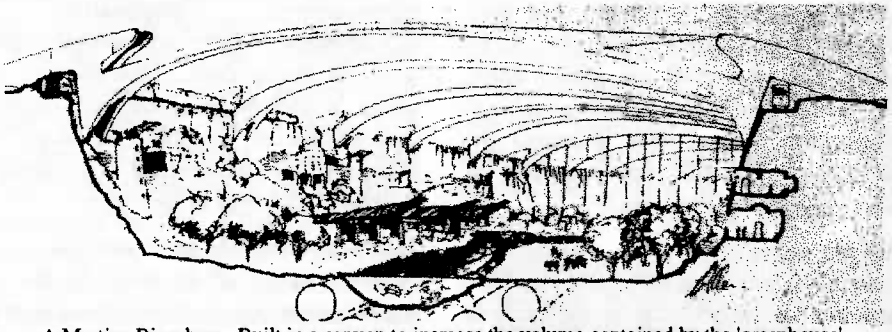
After the manned, short-stay exploration of Mars there may be the desire to return to and stay on Mars - to colonise it. Presently Mars is not suitable for life, but many people believe that with a little intervention, processes could be initiated or awakened in the planet to make it Earth-like. This is the science of planetary environmental engineering or terraforming. There are several possible ways of doing this. One method is to make a relatively small, self-contained 'greenhouse' or biosphere on Mars. The Biosphere 2 experiment conducted in Arizona, USA was of this type.

Plants and animals were carefully chosen to allow them all to exist in the huge sealed greenhouse without interaction with the outside environment. Problems such as low oxygen levels and a leaking biosphere occurred at times, not to mention biospherians disrupting the sensitive ecosystem by smuggling in chocolate.

Some scientists question Biosphere 2's scientific usefulness because of these events. Its value to tourism may have been greater than that to science, but the project has shown that this kind of self sufficiency is not as easy to achieve as it may initially appear. It may be a few decades before a Martian version of Biosphere 2 is safe enough to be attempted.

The biosphere approach is a technologically intense solution. It has the advantage that it could be set up very quickly, and there is, in theory, great control over the conditions inside. As this solution involves a lot of equipment and resources to set up, it is very expensive for the size of the habitat that can be engineered.

Another approach is a more biological one. Introducing powerful greenhouse gases, such as CFCs, into the atmosphere of Mars would reduce the amount of energy radiated back into space. The temperature of the planet would rise and eventually cause the Martian permafrost and any other frozen volatiles to sublime. »»



A Martian Biosphere. Built in a canyon to increase the volume contained by the 'greenhouse'.

This vapour would add to the Martian atmosphere, enhancing its insulating ability, so causing a further temperature increase, and more volatile release. This self-sustained transformation would continue until the atmosphere reached a surface pressure of 24 millibars (the partial pressure of water). At this pressure any water ice would no longer sublime but melt. Water would now be able to form into lakes, and the ecosystem would gradually stop changing and settle. Soon life would be able to survive on the planet.

This form of environmental engineering has the advantage of terraforming a whole planet. The disadvantage of this method is its speed. It has been estimated that to transform a Mars-like planet into an Earth-like one would take about 100,000 years. Ways of speeding this process up have been suggested. Large atmosphere processors could be set up on the planet to release oxygen from the iron oxide found in the Martian soil. Hydrogen peroxide is also found in large quantities in the Martian soil, and this can be used in a reaction with the carbon dioxide atmosphere to produce oxygen and water. The process would still take many hundreds of years to form a habitable planet.

The cost of a new world

To set up a small colony on Mars, using a biosphere type approach, would cost at least $80 billion. This is a large amount of money, yet a similar amount was recently spent on the Gulf War. During Reagan's presidency, twenty times this amount was spent on military build-up. The money is available if people wish to spend it that way. But why should they? That kind of money could be used for many other, possibly more worthy, causes. They may be right; money could be used to better the lives of millions of people in the short term. But what about the long term?

An interesting point has been put forward that may catch us out if we are unaware of it. We have always assumed that the world's economy would continue to grow and the standard of people's living would continue to rise. We would end up with better technology, meaning the colonisation of other worlds would become easier and quicker. But Earth's economy is presently based on non-renewable resources. When these resources are depleted the world's economy may begin to regress, and there could come a time when we are no longer able to support a mission to colonise Mars. Exactly when, or if, this situation will »»

arise is uncertain, but it could well come in the next century.

We now live in a period when the colonisation of other worlds could become a reality, or we could be living in a period of missed opportunity. It is still unclear in which direction our * future will turn. ¤

Daniel Cave

* See GA Allen, September 1993 Spaceflight.

BIBLIOGRAPHY

"The Environmental Model of Mars"; 2nd COSPAR colloquium proceedings, by K Szego (Editor), Pergammon Press 1991

"The Planetary System"; First Edition, by D Morrison & TC Owen; Addison - Wesley Publishing Company 1988

"The Cambridge Photographic Atlas of the Planets", by G Briggs & F Taylor; Cambridge University Press 1986

"Mars Alive"; BBC Horizon, first shown Feb 8, 1993

"MARSNET - A Network of Stations on the Surface of Mars"; ESA Journal: 1993, Volume 17, page 225

Aviation Week and Space Technology:

"Soviets proposed Relay Role for Mars Observer Mission"; December 21,1987, page 21

"White House Approves Soviet Talks on Moon/Mars Exploration Initiative"; April 9, 1990, Page 24

"President Bush Sets 2019 Manned Mars Objective"; May 21, 1990, Page 19

"Synthesis Group to Urge Rapid Lunar/Mars Pace, Support for Station Role"; June 3, 1991, Page 19

"Soviets Slash Mars Plans by Half, Continue Other Co-operative Ventures"; October 14, 1991, Page 68

"US Satellite Launch to Renew Mars Exploration"; August 17, 1992, Page 42

Spaceflight:

"Man on Mars: the Next Step"; July 1988, Page 268

"Some Unconventional Approaches to the Exploration of Mars"; February 1991, Page 62

"Discovery-Class Missions"; June 1993, Page 208

"Terraforming"; August 1993, Page 267

"Missions to Mars"; September 1993, Page 295

"Colonising Mars, the New Human Migration"; September 1993, Page 297

"Bringing Worlds to Life - Terraforming, the New Science of Planetary Environmental Engineering"; September 1993, Page 300

Sky and Telescope:

"The Legacy of Phobos 2"; February 1990, Page 156

"Slithering across Mars"; News Notes, March 1991, Page 241

"Mars Rover on the move"; News Notes, May 1992, Page 487

"Return to the Red Planet"; October 1992, Page 373

Astronomy:

"Searching for the Waters of Mars"; August 1989, Page 20

"The Ice Ages of Mars"; December 1992, Page 41

"Did Mars Once Have Martians?"; September 1993, Page 26,

"Mars: The Russians are Going!, The Russians are Going!"; October 1993, Page 29

PICTURE CREDITS

The Cambridge Photographic Atlas of the Planets, page 152

Sky and Telescope, October 1992, page 374

Spaceflight, December 1993, page 408

Spaceflight, September 1993, page 299 ¤

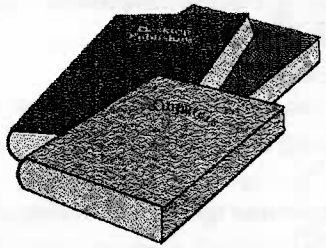
FAS Newsletter

The December edition of the Newsletter of the Federation of Astronomical Societies is now available for members to collect at the Observatory. Our newsletter Sagittarius is given a special mention, with the comment that it must be one of the biggest publications for amateur societies.

Book Reviews

The Time and Space of Uncle Albert

by Russell Stannard



I suppose the equation $E=Mc^2$ is probably the most famous equation in the world, and the man who formulated it, Albert Einstein, is acknowledged as one of the greatest scientists of all time.

This wonderful book introduces the reader to the secrets and key elements of Einstein's Special Theory of Relativity. It is a remarkable piece of work, ideal for children and science enthusiasts of all ages.

Uncle Albert is a renowned scientist who has developed a thought bubble to help him develop his scientific ideas. His niece, Gedanken, is 'beamed up', a la Captain Kirk fashion, into the bubble with the help of the on-board computer, Dick, and begins to help Uncle Albert unravel some of the mysteries of time and space.

It is without doubt a most engaging and thrilling book, full of original ways of presenting some rather complicated scientific ideas in a manner which makes them down to earth, easy to understand and retain the reader's interest and imagination.

It's a first-class read.

Black Holes and Uncle Albert

by Russell Stannard

Following on the success of his first book, *The Time and Space of Uncle Albert*, Russell Stannard published this volume, which delves the mysteries of Einstein's General Theory of Relativity.

The same characters from his first book, Uncle Albert, his niece, Gedanken, and the thought bubble computer, Dick, explore the wonders of space, time and black holes, with near fatal consequences!

I did not find this book (which may be read as a companion to the first title, or on its own) such an absorbing or easy to follow piece of work. The children I have read it to have enjoyed it, but found some of the concepts a little harder to assimilate. Nevertheless, it is a challenging and absorbing book, which will require you to keep your wits about you.

Together, the two books bring Einstein's work down to earth for mere mortals like ourselves, and the author is to be congratulated for presenting science in a fascinating and uncondescending manner, which sadly many scientists unwittingly fail to do.

The author, Russell Stannard, is Professor of Physics at the Open University, and Vice-President of the Institute of Physics. He has travelled throughout the world, and undertakes research work into high-energy nuclear physics. ¤

David Williams

"The Time and Space of Uncle Albert" (pp120), and "Black Holes and Uncle Albert" (pp145) are published by Faber and Faber, in 1989 and 1991, respectively.

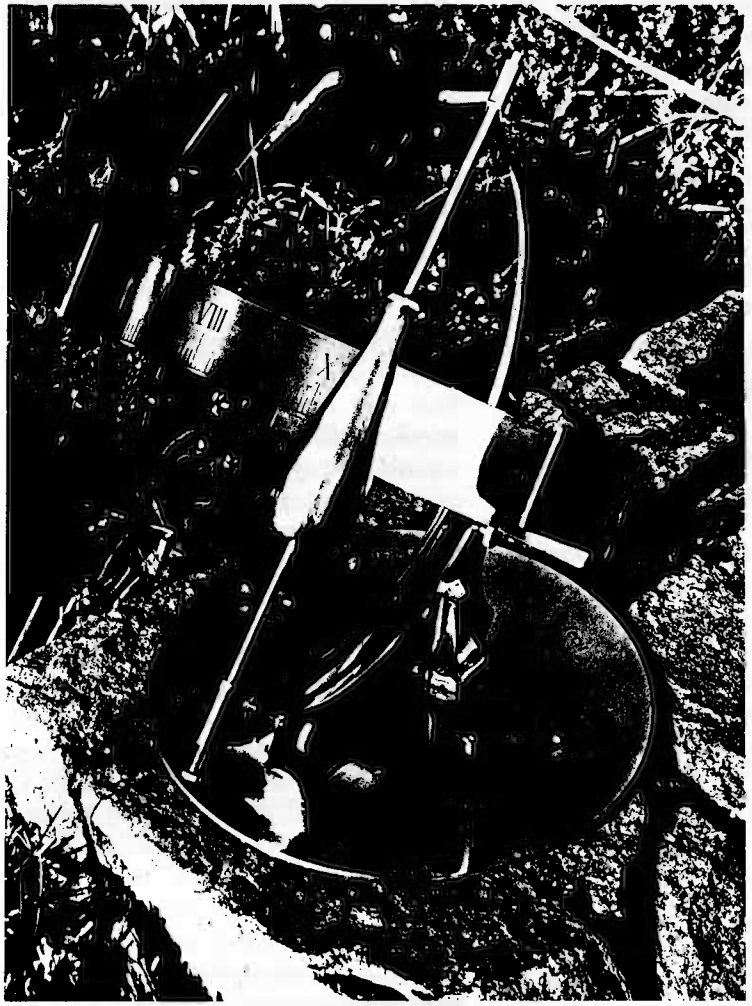
The sundial as an astronomical instrument

I recently acquired an equatorial sundial - a beautiful brass instrument. The design is unique in that the sundial shows clock time rather than sun time. This is achieved by a combination of adjustments to allow, not only for latitude (some other sundials have latitude adjustments or are designed for the latitude of their location), but also for longitude, the Equation of Time, and even the time zone, such as summer time.

The provision for the Equation of Time is most unusual in than it is built into the shape of the gnomon. Actually, there are two gnomons: one for midsummer to midwinter, and the other for midwinter to midsummer. They are changed with the season.

Why are these adjustments necessary?

The ***Equation of Time*** at a given moment is defined as the difference between the Right Ascension of the Mean Sun and the Right Ascension of the True Sun. It varies throughout the year, and at its extremes is minus 14½ minutes and plus 16½ minutes.



The ***True Sun*** moves at an irregular angular rate, because of two factors: (a) the Earth's orbit is elliptical, not circular, and (b) the Sun's apparent path (the ecliptic) is at an angle of 23½° to the celestial equator (because of the tilt of the Earth's axis to its orbital plane).

The ***Mean Sun*** is a fictitious body which moves along the celestial equator at a fixed rate. It has the convenience of being regular, and thus forms the basis of clock time.

»»

The difference between the Mean Sun and the True Sun, or the Equation of Time, thus gives the "correction" which needs to be applied to the time shown by a sundial in order to obtain the time shown by a clock. The term "correction" is really a misnomer, because, if the sundial is set up correctly, it is not wrong - it is simply showing sun time, not clock time.

Many people look at the shadow cast by a sundial's gnomon, and say it is showing the "wrong" time because it does not show the same time as their watch. They are rather like Passepartout in "Around the World in 80 Days", who, in response to the suggestion that he regulate his watch in each country, retorted:

"I, regulate my watch? Never!"

"Well then, it will not agree with the Sun."

"So much the worse for the Sun, Monsieur; the Sun will be wrong then!"

At least two adjustments must be made to the time shown by a sundial in order to get the time shown by a watch:-

1. The time equivalent of the longitude of the location. For example, Guernsey is 2½° west of the Greenwich meridian (which is the meridian corresponding to our time zone). Therefore the Sun time is 10 minutes later than clock time (because the Sun "moves" approximately ¼° per minute). Some sundials, especially old ones which are designed for a particular location, may take this into account in their design.

2. The adjustment corresponding to the Equation of Time for the date. Some sundials incorporate a plate showing the curve of the Equation of Time, or sometimes a list of the values of the Equation of Time by date.

And of course, a third adjustment may have to be made for summer time (or for European Time if Guernsey moves to it).

Other important, but often overlooked, points are that the angle of the gnomon must correspond to the latitude of the place where the sundial is set up, the base of the sundial must be horizontal (for a horizontal sundial), and the sundial must "point" north (or south in the southern hemisphere). People often buy sundials which are made, for the UK, for example, and then set them up in Guernsey, which is several degrees further south.

So, next time you check a sundial, remember it is basically an astronomical instrument, designed to show sun time, (and then only if set up correctly) and not clock time - unless it is my new sundial! ¤

David Le Conte

My equatorial dial was made by Silas Higgon of Connoisseur Sun Dials, 19 Ridgeway Avenue, Coventry CV3 5BP, telephone 0203 415250. He makes a variety of types: analemmatic dials, armillary spheres, wall dials specially designed for the location, horizontal dials (with built in equation of time plate). He also makes separate Equation of Time plates for mounting next to existing dials, and indoor dials for display: shepherd's dial, harp dial, equatorial, analemmatic, and paper weight.

In the next issue I will discuss the Equation of Time in more detail.

Don't forget!

Your subscriptions to La Société and to the Astronomy Section are now due.

The British Sundial Society

Having recently acquired an interesting sundial (see article in this issue) I sent for information about the British Sundial Society. The Society was formed in 1989 by a small group of enthusiasts, and now has a membership of almost 500.

Its objects are:-

1. to promote the science and art of gnomonics, and the knowledge of all types of sundial;

2. to catalogue the dials which still exist in the British Isles, and research their history;

3. to advise on the preservation and restoration of old sundials, and the construction of new ones; and

4. to publish and circulate to Society members periodically, a Bulletin or Journal containing original articles, reports from other societies, news and other items of interest to members.

The Society has an Education Group, which has produced a book "Make a Sundial", and is preparing a video. They also have records of some 2,000 fixed dials, with the goal of recording most of the dials in the British Isles.

The Society points out that:

"sundials are unique in the combination of science, art and craftsmanship, and have been in use for thousands of years as a tool for telling the time. Although, in the last hundred years the sundial has become largely obsolete for this purpose, in recent times there has become a greater awareness of the fact that those many sundials that still exist are part of our national heritage and should be preserved."

"There has also been a resurgence of interest in the old science of gnomics and in the design and construction of new dials both to replicate the old and to create new and exciting artistic designs whilst incorporating the scientific accuracy of the true sundial."

The contents of the Society's Bulletins make interesting reading, with titles such as:-

A double analemmatic noon mark.

Reflected ceiling dials.

A latitude-independent sundial.

The Roman cylindrical sundial.

Sundials at Jodrell Bank.

A "human" sundial.

Sundial calculations for computers.

A holographic sundial.

Telling the time by the spire.

The astronomical quadrant.

A self-orienting equi-angular sundial.

Using Polaris to align a gnomon.

Moondials.

What is time?

Helical sundials.

A tidal dial.

Dialling on Uranus.

and inevitably . . . The Equation of Time. ¤

David Le Conte

Membership details from: Robert B. Sylvester, BSS Membership Secretary, Barncroft, Grizebeck, Kirkby-in-Furness, Cumbria LA17 7XJ (Tel, 0229 89716).

Subscriptions: Individual £15, Family £20.

The BAA at Christmas

Astronomy with mince pies

David Williams and I were fortunate to have the opportunity of attending the Christmas meeting of the British Astronomical Association. This took place in the Scientific Societies' Lecture Theatre at 23 Savile Row, London, on the 18th December at 2.30 pm, and included a glass of wine and mince pies! There was a number of trade stands.

After the reading of the minutes by Dr. John Mason, and the ordinary business of the Association, Martin Moberley gave a roundup of recent astronomical events and forthcoming ones.

Clusters of galaxies

This was followed by the main event of the day: a lecture by Professor Wilmore of Birmingham University, on the evolution of clusters and groups of galaxies. Professor Wilmore stressed the benefits of observing such structures in different wavelengths; x-ray observations complement those in the visible part of the electromagnetic spectrum. Clusters (which can contain from a few galaxies up to thousands of galaxies) show a large ball of emission in x-rays, but may be point sources in the visible. The x-ray emission is given by hot gas, and shows that the cluster must be held together gravitationally by a large amount of matter (otherwise it would disperse into the surrounding vacuum of space). The amount of matter required is more than the sum of the observed gas and galaxies, and the deficiency is "dark matter".

Theories of galaxy formation fall into two groups: bottom-up (ie built up from smaller units) or top-down (subdivision of a large amount of matter). Computer simulations of the combining of small blocks of matter to form clusters of galaxies are quite convincing.

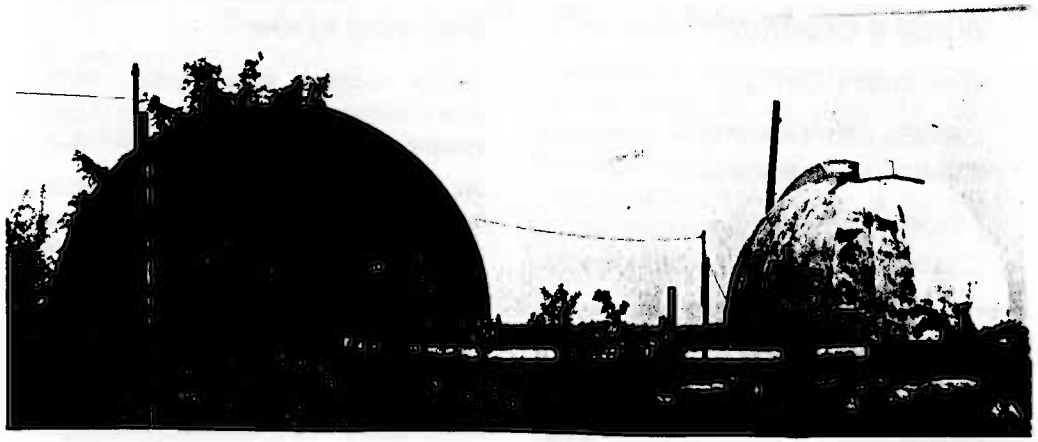
However, material is being lost from galaxies by two processes. Professor Wilmore showed data from x-ray satellite observations indicating that the x-ray emission (ie the gas) trails behind large galaxies, such as M86 which is being drawn towards the giant elliptical galaxy M87. The pressure at the "front" end of the galaxy strips interstellar material from it, and this process, he said, converts elliptical galaxies into spirals. Observations show that the more dense the cluster the greater the number of ellipticals and the fewer the spirals.

The second process is the ejection of material from galaxies by supernovae explosions. This process also produces the heavy elements (the original universe being composed entirely of hydrogen and helium). It has taken three or four generations of galaxies to produce the material of which our bodies are composed.

The Perseus cluster of galaxies shows no iron in the outer regions, only in the core, because material has been stripped from galaxies passing through the centre of the cluster. Small clusters, consisting of just three or four galaxies, show x-ray emission from hot gas in the same place where it was when the group formed. The galaxies will eventually combine to form a giant elliptical, but the x-ray emission still shows the original form of the cluster, and can be thought of as a "fossil" galaxy. Professor Wilmore said that probably all galaxy clusters will end up this way. ¤

David Le Conte

In the next issue: the future of planetaria.



A visit to . . . Newchapel Observatory

When I was on holiday last September I visited Newchapel Observatory, which is just north of Stoke-on-Trent. The Observatory was built on waste ground using new and second-hand materials. It was started some thirty years ago, in 1964.

They have a planetarium, and an exhibition building of dinosaur fossils which were found in the Isle of Wight. There is also a gift shop where small gifts can be purchased.

Mr. Michael Pace, who runs the Observatory, showed me their 18-inch reflecting telescope, which is housed in a domed building. It was practically built by the members themselves.

Although the Observatory is situated in the suburbs of a built-up area, light pollution is less of a problem than first thought. Mr. Pace told me that the telescope is used for serious studies, and from time to time groups of school children visit the Observatory as part of their studies.

There is a conservation and picnic area, wind generators, and solar collecting panels which heat the exhibition building.

I recommend anyone who is in the Stoke-on-Trent area to visit Newchapel Observatory. Although I found it difficult to find, I was assured that the Council would be erecting better signs to it. ¤

Roger Chandler

Roger has a leaflet which shows that the Observatory is just off the High Street in Newchapel. The Observatory and planetarium are part of the Natural Sciences Centre.

Opening times:

Monday - Friday	*9.30 am - 5.00 pm*
Sunday	*10.00 am - 5.00 pm*
Thursday evening	*7.30 pm onwards*

Other evenings by arrangement.

Prices of entry:

Adults	*£2.00*
Juniors/Concessions	*£1.00*

Telephone: 0782 785205 (Observatory)
0782 876514 (Home)

What a cracker!

Motto found at Christmas:-

Teacher: "What is a comet?

Child: "A star with a tail."

Teacher: "Name one."

Child: "Lassie."

Hubble? No trouble!

The Hubble Space Telescope repair mission in December went exceedingly well. It was good to see the excellent pictures of the spacewalks on television, each one going better than the last. All the tasks were carried out, including the replacement of gyroscopes, solar panels, the wide-field/planetary camera, and of course Costar, the corrective optics.

We now wait for a few weeks to get confirmation that all is working as it should, and those crisp, clear pictures so long awaited. The HST has already produced important scientific discoveries, even with its handicaps, and now its full potential should at last be realised.

School children to observe the Moon

On Thursday the 20th January at 6.00 pm children from La Houguette School will visit the Observatory to observe the Moon. They have been studying the Moon at school, and their visit will follow a talk by David Le Conte at the school that afternoon.

The Moon, at first quarter should be ideal for observing, so let's hope for a clear sky. It would be helpful if some members were present to assist on this occasion.

Did you know?

NASA scientists have recently carbon-dated radioactive elements of the Allende meteorite, which fell on Mexico in 1969.

As a result of heating when the planets were formed, the composition of the rocks changed several times, so the oldest rocks on Earth are dated at 500 million years or less. Many meteorites have turned out to be made of a similar composition.

It is thought that many meteorites have been expelled from the other planets due to volcanic action or asteroid collision, so most of the meteorites which get through to our Earth's surface are made of the same composition and the same age. But no meteorite has been found to be older than the "Allende", with an estimated date of 4,560 million years old. It is thought to be as old as the solar system itself.

Antony Saunders

Asteroids for the HST

The weather conditions for observations of Asteroid Else in support of the Hubble Space Telescope's observations in November were very poor. A week or so after the main period for observation the weather improved somewhat and a search was made. However, this was inconclusive.

Photographs taken with the 14-inch telescope in October and November have been studied for evidence of both Asteroids Jokaste and Else, but the lack of an adequate means of guiding resulted in trailed images, and the faint asteroids did not register.

Letter to the Editor

Dear David,

Many thanks for the fascinating article on Orion the Hunter in the November/ December newsletter.

I once spent a year in New Zealand, a long time ago, before I took much interest in the skies above, but I remember thinking, during their summer nights in December, that Orion had a distinctly odd look - his dagger appeared to be pointing upwards - and then of course I realised that the constellation was upside down.

Sirius, the faithful hound, was not at Orion's heels, but gambling in the sky above his head.

I wondered then whether if Ptolemy, or whoever it was who named these stars, had happened to be living in New Zealand, he might have called Sirius the Falcon?

Yours sincerely, Felicity Belfield
Beauchamp, Sark

We are happy to publish readers' letters. Why not write with your comments on an article, or with any other views?

Fireball seen

Mr. & Mrs. Mike Prosser reported a fireball between 8.30 pm and 9.00 pm on Friday, the 3rd December 1993. It was moving from east to west across the northern sky, and appeared to break up, leaving a trail of pieces behind it. Did any member see it, or had it reported to them?

The sounds of Jupiter

Following the publication in the last issue of Sagittarius of an article by Mark Humphrys about amateur radio astronomy, Rex Huddle has successfully picked up the radio emissions from Jupiter, as described in the information from the Society of Amateur Radio Astronomers (SARA).

Rex scanned the 18 to 22 MHz short-wave radio band, as suggested. At the frequencies 19.202 MHz and 19.754 MHz the distinctive sounds could clearly be heard.

Rex brought his radio along to the Observatory, but it was not possible to receive the signals after Jupiter had set. However, he was able to make a recording of them which he played to members. It certainly sounded just like the description given by SARA - rushes of sound, like the sea breaking on a beach. There were also occasional booming sounds.

It would be interesting to correlate the signals with transits of Jupiter's moon Io, as suggested by SARA. The advantage, particularly at this time of the year, of this kind of astronomy, is that it does not rely on good weather, and can be done in the daytime, in the comfort of one's own fireside! Very simple equipment is all that is needed. Rex's radio is a portable instrument, with a simple wire aerial.

Hot home?

Talking of warm firesides, a friend has just moved from the Space Telescope Institute in Baltimore to the Sacramento Peak Solar Observatory in New Mexico. His new address is most appropriate. The town is called Sunspot, and his street is named Corona Loop! ***DLC***