TAILPIECE

Advertisements

This space is available free to members for advertisements (preferably, but not necessarily astronomical).

1997 Programme and Astrocalendar

The Programme of events for next year is now in preparation. Anyone wanting to give a talk should contact Geoff Falla as soon as possible. We look forward to an exciting programme, as usual.

Copies of the 1997 Astrocalendar have now been received. The monthly notes run from October 1996 through to the end of 1997. I was recently looking at the Times edition of monthly sky charts and details of planetary positions, at a cost £3.50! The FAS Astrocalendar provides much more information, better charts, and costs only £1.50. Section members, of course, get a free copy, but if you want to buy any extra copies (as Christmas presents?) they are available to members at just £.25. ☆

Not what it seems!

"***Comet:*** *A single arm of an asteroid which is in the process of regenerating a new disc and arms.*"

"***Asteroid:*** *An echinoderm of the class Asteroidea which includes the sea stars (starfishes).*"

From Dictionary of Biology, by Edwin B Steen; Barnes and Noble, USA, 1971.

☆

No sponsor has been found for this issue.

If you know of a potential sponsor please let us know so that they can be contacted.

The cost is £25.

Sagittarius OnLine, the Astronomy Section's home page on the World Wide Web, has had to be suspended for a few weeks while we change host computer systems. It will hopefully be operational again by the New Year, and the new address will be included in the next issue of Sagittarius.

Astronomy Section Officers

Section Secretary:	Geoff Falla	724101
Honorary Treasurer:	Peter Langford	720649
Light Pollution Officer:	Ken Staples	54759

The next newsletter will be published early in January. The deadline for publication copy is the 15th Decmber.

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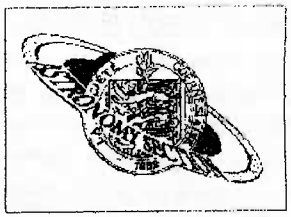
Sagittarius

The Newsletter of the Astronomy Section of La Société Guernesiaise



November/December 1996

Forthcoming events

The Discovery of Neptune
by Frank Dowding
Tuesday, 26 November
8.00 pm at the Observatory

Quiz and Supper Evening
led by Debbie Quertier
Tuesday, 10th December
7.30 pm at the Observatory

also:
Every Tuesday at 7.30 pm
(not 24th and 31st December)

and:
Every Friday evening
(if clear)

In this issue

Light pollution
Life on Mars
FAS Convention
Millenium projects

Inside

Major articles are in **bold**

Centre inserts

November/December star chart
Moon phase calendar

The discovery of Neptune

At 8.00 pm on Tuesday, the 26th November, Frank Dowding will speak on *The Discovery of Neptune*. This has been much in the news lately, as this year is the 150th anniversary of the discovery.

Frank will discuss the theory behind the calculations which led to the first sighting of this planet in 1846, and will put it in the context of mid-19th century social life, communications, and instrumentation.

The discovery of Neptune is a fascinating story, not without an element of misunderstanding and controversy, involving some diverse characters. Frank's speciality is the solar system, and this should prove an interesting evening. ☆

Quiz and supper evening

The annual binge will be held **on Tuesday, the 10th December** (not the 5th as stated in the Programme) **at 7.30 pm** at the Observatory (note the early start).

The supper part of the evening will, as usual, consist of a pot-luck of food and drink brought by members. The food should preferably be something which can be eaten with the fingers, and shared with others.

Debbie Quertier will be the Quizmaster this year. As usual, we will probably have two teams, with members answering questions individually in turn, and with passes or incorrect answers being referred to anyone in the other team. This is not as gruesome as it may sound, and we tend to have much fun, while learning a lot. (All of us can do that!)

So, come along and enjoy the evening, which will have a Christmas flavour. ☆

National Astronomy Week

National Astronomy Week lasted from the 22nd to the 29th September, and the Astronomy Section made the most of it. We made all the media in one way or another, with BBC Radio Guernsey especially giving good coverage. We were featured on the radio every day from Monday to Friday, with sometimes two interviews in one day. Ken Staples and David Le Conte between them appeared on Pat Lihou's morning programme each day.

The subjects included the discovery of Neptune 150 years ago, the lunar eclipse, and what was becoming visible in the night sky. Indeed, Pat did us very well, even attending our event at La Houguette School on the Tuesday.

That event was surprisingly well attended, with about 50 people present, despite discouraging weather. There was an excellent attendance by members. Geoff organised the evening, and showed a large collection of colour slides of solar system objects. This was followed by a video, presented by David, about the Voyager fly-by of Neptune. Unfortunately, the weather prevented observations of Jupiter and Saturn. Nevertheless, people seem to have enjoyed the evening, and sales of publications were good.

The total lunar eclipse in the early hours of the 27th September was observed from the Observatory by a lone David, although it is understood that some other members observed from their homes. The weather was windy, cloudy and rainy, but nonetheless glimpses of the eclipse at all stages were seen, and a few photographs were taken. It gave the appearance of being quite a bright eclipse, largely because it was far from being a central one. ☆

Is anyone out there?

On Tuesday, the 27th August, Antony Saunders gave us a talk about the possibility of life elsewhere in the universe. He started by reminding us that the life is based on cells and carbon. It is believed that life started 4.2 billion years ago. The oldest fossils date from 3.5 billion years ago, and the first vertebrates appeared 500 million years ago.

Life started on the Earth either from the synthesis of basic chemicals, or from outer space. Amino acids have been found in meteorites, which could have spawned life throughout the universe. Life on Earth could even have been made by other life, as an experiment! Life requires free oxygen, water and sunlight. More animals have come and gone than exist on the Earth today.

In 1859 Darwin proposed a single origin for all species. The dinosaurs could have developed into intelligent reptiles, if they had not been wiped out. ET could look something like man, because eyes, ears, hands, etc have been very successful.

Antony described the search for life on Mars by the Viking spacecraft, messages sent with Pioneer and Voyager, and the radio message sent to M13. In 1983 IRAS discovered a dust cloud around Vega, with about the same amount of matter as our solar system. A dust cloud has also been found around β Pictoris.

Recently, the existence of seven planets around other stars has been detected. It is possible that 50% of all stars could have planets, and that 25% of those could have water in a stable state. Antony concluded an interesting talk by referring to the recent discovery of evidence of life in a Martian meteorite. ☆

Observatory Open Day and the solar eclipse

Saturday, the 12th October saw our main event of the year. The Observatory was open to the public from 1.00 pm to 10.00 pm. Again there was good turn-out of members, which was most encouraging. During the day we had an estimated 80 to 90 people visit the Observatory, with a further 40 or so in the evening.

The weather started quite indifferently for the partial solar eclipse, with the first hour of the eclipse largely cloudy – just a few tantalising glimpses of the increasingly eclipsed Sun. However, just before 3.00 pm (about 20 minutes before maximum eclipse) the sky cleared, and excellent views were had of the rest of the event.

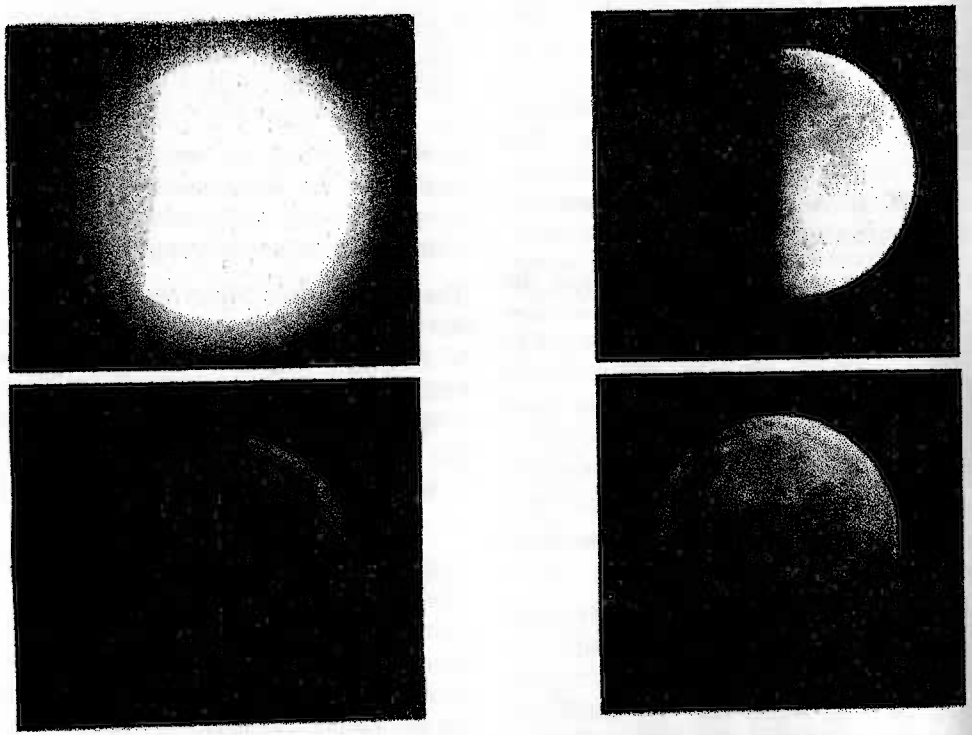
The large crowd saw the Sun projected onto a screen by the Section's new 6-inch solar telescope (focal length about 67 feet). Gareth Coleman worked this instrument, keeping a sharp image of the Sun focused on the screen. A picture of it appeared on the front page of the *Guernsey Evening Press* on the following Monday, along with a group of children at the Observatory observing through solar filter glasses.

Lawrence Guilbert, who had been responsible with Gareth for the solar instrument, also set up his 4-inch refractor with the projection method, as did Roger Chandler with a pair of binoculars. David Le Conte concentrated on photography though the 11-inch Celestron, and piggyback on the 14-inch.

The evening was quite clear, and good views of Jupiter, Saturn, Comets Hale-Bopp and Tabur, and other objects were obtained.

About £100 was gained from the event. ☆

The total lunar eclipse of 1996 September 27



The progression of the lunar eclipse was photographed on TMax 400 film by David Le Conte, using the 11-inch Celestron telescope at prime focus with a telecompressor. Details of times and exposures are:-

Top left:	0127 UT (15 minutes after the start of the eclipse).	1/8th second.
Top right:	0137 UT.	Exposure 1/15th second.
Bottom left:	0300 UT (totally eclipsed)	Exposure 15 seconds.
Bottom right:	0306 UT.	Exposure 20 seconds.

Most of the photographs were taken through small, fleeting gaps in the fast-moving clouds. The last picture was cut short by cloud moving across the field of view.

The cause of night?

Report on the 1995 Key Stage 2 Tests and Tasks in English, Mathematics and Science

Test B, question 1 (sun and light) "required children to show an awareness of the spin of the Earth, as well as the sun as a source of light as factors giving rise to night and day.

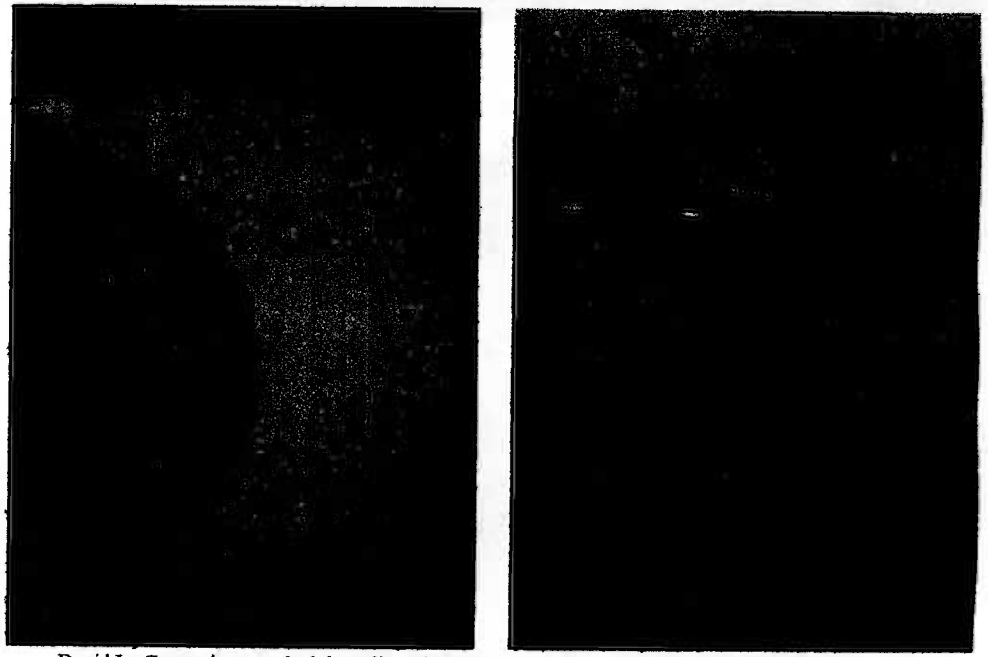
More children demonstrated understanding of the latter idea. Some children at the lower levels were confused about the role of the moon. They suggested this caused night."

So, shouldn't a lunar eclipse produce daylight?

☆

The partial solar eclipse of 1996 October 12

Gareth Coleman controls the heliostat of the new solar telescope to direct the Sun's image onto the focusing mirror, and thence onto a screen inside the building. It was very successful, and caused much interest.



David Le Conte photographed the eclipse through the 11-inch Celestron, using a 5-inch solar filter and telecompressor on Polaroid 100 ASA print film at 1/60 second. And that infamous tree which so often blocks our south-west view proved useful in producing multiple pinhole-camera images of the eclipse on the roadway.

The light at the end of the tunnel

Astronomers, everywhere, point their telescopes and binoculars skywards in search of their light at the end of their "Telescopic Tunnel". Sometimes, little pinheads of light, so far away that we would not live long enough to reach there, travelling by normal methods. Even if we could travel at the speed of light, (186,000 miles per second), it would take us **2.2 million years** to reach our closest and most similar galaxy ***Andromeda***. This galaxy also happens to be the farthest object away in space that can be seen with the naked eye. How frustrating it becomes when the light from Andromeda, having taken 2.2 million years to reach us, annoyingly gets blotted out from view in the last fifty miles or so by the intrusion of **unwanted light pollution** escaping into our atmosphere.

On some special and very rare occasions,we become fortunate to be able to witness a visiting comet, or perhaps meteorite, on its long orbit around the Sun, only to be totally disheartened by **unwanted light pollution** escaping into our atmosphere and removing our best opportunity of seeing this all too infrequent phenomenon.

Sometimes we would like to be able to enjoy, with perhaps a new enthusiast to our hobby, the majestic sight of Saturn with its rings, poised there low in the sky, just above the horizon, only to have it snatched from view by **unwanted light pollution** staining the darkness that we so desire.

Light pollution of our skies has **NO** justification. It is unwanted and unnecessary, and has no bearing in any logical discussion on the matter.

Direct light pollution (light that is pointing directly upwards to the sky), cannot be justified for any reason, other than if you are an airline pilot needing to see the runway. In this instance it is **not** a pollutant, but a very necessary sight for the safe arrival of that aircraft.

Indirect light pollution (light pointing downwards and reflecting upwards) also cannot be justified, as, obviously, the amount of light being used is above that which is sufficient to accomplish the same result; eg bright light being used by commercial premises for security would actually defeat the object for which it was intended, as bright light produces dark shadow – dark enough for persons to hide in. If we were to use only enough light to achieve the required effect, we would not only go a long way towards removing this nuisance, but would actually be saving money whilst doing so. By this action, we would also significantly reduce the amount of **heat** filtering into space, and we all know the dangers of that particular problem.

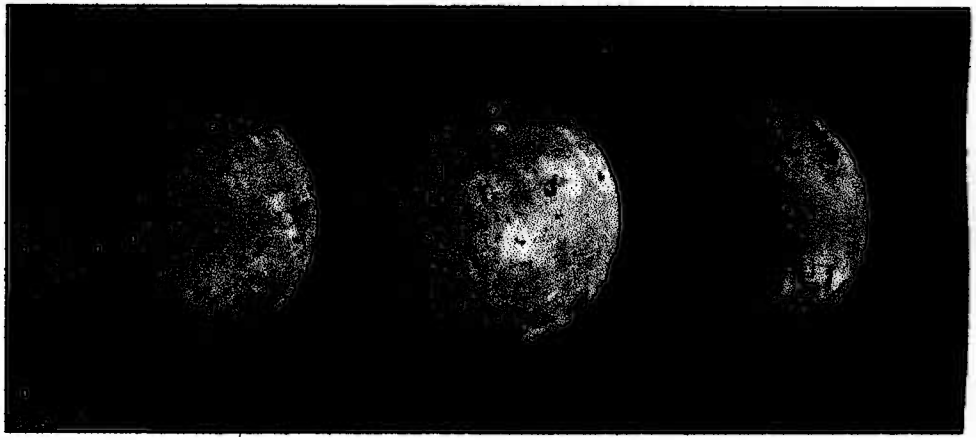
Light pollution at this moment in time is enjoying quite a high profile in comparison to normal, but we must not merely bask in that glow but continue to strive for an even better level of understanding through education and instruction.

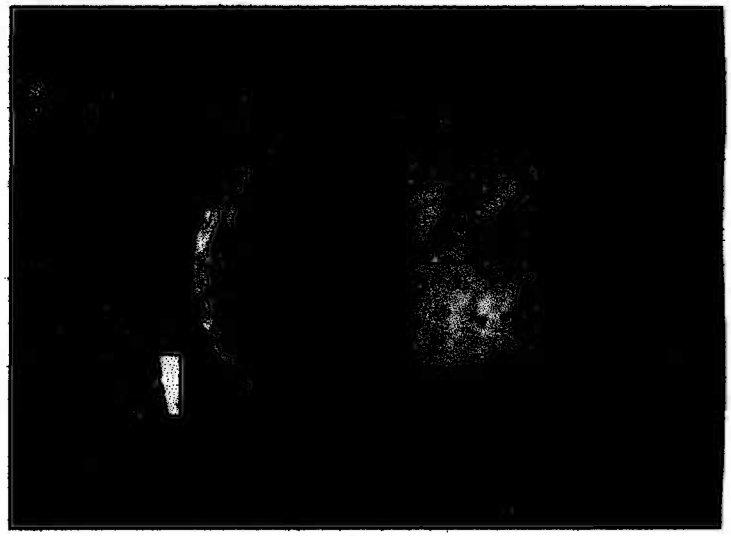
We can see a **light at the end of the tunnel** as far as the reduction of this particular pollution is concerned, but it will only be achievable with the continued demand for high levels of understanding and care for our planet, and the sustained support of everybody to ensure that the search for perfection must not be left to a dedicated few, but must be accepted as the responsibility of us all to strive to make it a better place for those that follow us.

Ken Staples

Galileo at Io

The images below were downloaded from the Internet by Daniel Cave, and show Jupiter's moon Io, as seen by the Galileo spacecraft. ☆





Observing Programme – November/December 1996

This last Section of the Observing Programme covers the area of sky from Right Ascension 01.00 hours to 05.00 hours, bringing us back to the starting point in the constellation of Orion. Many objects visible with binoculars are included in this Section.

In the constellation **Perseus** we have the double open cluster known as the *Sword Handle*. Each part of this cluster covers an area of about half a degree in diameter, so is best seen with a low magnification, and is visible in binoculars. Perseus also contains the variable star *Algol*, the prototype eclipsing binary. There is a ten hour eclipse, more than halving Algol's brightness at intervals of just under three days.

The constellation **Andromeda** has one of the best double stars, named *Almach*. The star can be found at the northern end of the constellation, has a good colour contrast with its companion, and a separation wide enough to be seen with a moderate magnification. Below Andromeda the small constellation Triangulum has a spiral galaxy *M33*, fairly bright at around magnitude 6.

The best known open star cluster, *the Pleiades* (*M45*) is in **Taurus**. The cluster covers an area of about 1½ degrees, so is best seen with a low power, giving a wide field of view.

Another variable star, *Mira 'The Wonderful'* is located in the constellation **Cetus**. Unlike the variable star Algol, Mira apparently pulsates, changing size and colour, and has been found to be several hundred times larger than our Sun. Mira's brightness varies between magnitude 2,5 and a faint 9.3 over a period of around 330 days. Cetus also contains the face-on spiral galaxy *M77*.

Constellation **Eridanus** extends from Orion down to and beyond our southern horizon. It contains the planetary nebula *NGC 1535*, at magnitude 9; the double star 32, which has good colour contrast, and the triple star *Omicron 2*.

A summary of the objects included in the six Map Sections covering the year will list the objects by constellation and by type of object with Map Section references. This will help to locate all of the listed objects more easily, and is planned to be the concluding part of the Observing Programme.

Geoff Falla

The summary will appear in the next issue of Sagittarius.

The table of objects for November and December is on page 9, the star chart is on pages 10 and 11, and the observing log is on page 12. These centre pages can be removed for convenience. ☆

Public programme

David spoke to the St Martin's Women's Institute on the 3rd September, and to the St Andrew's WI on the 9th September. On Wednesday the 10th September about two dozen Canadians on an "Elderhostel" tour visited the Observatory. The local part of this tour was organised by La Société. We also continue to have a steady stream of visitors on Tuesday nights. ☆

STAR CHART - SECTION 6

Constellation	Object	Type (○○ = Should be visible with binoculars)		Coordinates RA h m	Dec degs
CASSIOPEIA	M 103	Open cluster		01 33	+ 60.7
	NGC 457	Open cluster	○○	01 19	+ 58.3
	Iota ι	Triple star		02 29	+ 67.4
PERSEUS	NGC 869	Open cluster	○○	02 19	+ 57.1
	NGC 884	Open cluster (*The Sword Handle double cluster*)		02 22	+ 57.1
	NGC 1528	Open cluster	○○	04 15	+ 51.2
	NGC 1245	Open cluster	○○	03 15	+ 47.2
	Beta β	Variable star (*Algol*)	○○	03 08	+ 40.9
	M 34	Open cluster	○○	02 42	+ 42.8
ANDROMEDA	Gamma γ	Double star (*Almach*)		02 04	+ 42.3
	NGC 891	Spiral galaxy		02 23	+ 42.3
	59	Double star		02 11	+ 39.0
	NGC 752	Open cluster	○○	01 58	+ 37.7
TRIANGULUM	M 33	Spiral galaxy		01 34	+ 30.7
ARIES	Gamma γ	Double star		01 54	+ 19.3
	NGC 772	Spiral galaxy		01 59	+ 19.0
TAURUS	M 45	Open cluster (*The Pleiades*)	○○	03 47	+ 24.1
	Chi χ	Double star		04 23	+ 25.6
	NGC 1647	Open cluster		04 46	+ 19.1
CETUS	M 77	Spiral galaxy		02 43	00.0
	Omicron ο	Variable star (*Mira*)		02 19	- 03.0
ERIDANUS	32	Double star		03 53	- 03.0
	Omicron2 o^2	Triple star		04 15	- 07.7
	NGC 1535	Planetary nebula		04 14	- 12.7

STAR CHART
SECTION 6

Scale: Approx 5 Degrees

Polaris

CASSIOPEIA

ι

I. 1103

NGC 457

NGC { 869 / 884

NGC 1528

Capella

NGC 1245

ANDROMEDA

NGC 891

κ 34

γ

β

59

NGC 752

AURIGA

PERSEUS

TRIANGULUM

I. 25

χ

I. 45

NGC 1647

TAURUS

ARIES

γ

NGC 772

Aldebaran

CETUS

ORION

κ 77

ο

32

Rigel

ο²

NGC 1535

ERIDANUS

05 HR

01 ER

10

11

STAR CHART - SECTION 6 OBSERVATION LOG

Date	Constellation	Object	Observation notes, etc

Life on Mars – The Silly Season

The summer seems a long time ago. The nights are now beginning to draw in, and the days of autumn are fast approaching. I would like you all to cast your minds back to those heady sunshine months of July and August.

Now, are you sitting comfortably, eyes closed and recalling those warm summer days? Well, if you are – STOP IT!! Open your eyes and read on.

August is often referred to by the media as 'The Silly Season'. It's that time of year when no great or interesting news stories usually break. Parliament is in recess, and the Royal Family is tucked quietly and safely away in the glens of Scotland.

It was, therefore, with a degree of scepticism that I read one morning: "*Life on Mars – We Are Not Alone!*" As far as I was concerned this headline came straight from the X-Files, but closer inspection proved me wrong.

We all know that NASA scientists have found microscopic bacteria on a meteorite fragment recovered from Antarctica, and thought to have originated on the planet Mars, having landed in the frozen wastes approximately 13,000 years ago.

This news sparked off a great deal of discussion on television, in the newspapers, and voluminous correspondence to the letters page of many papers. Much of it concerned the imminent demise of religious belief, because, if life existed elsewhere then religion as we understand it – our belief in God – is all tosh. But why should this be so?

I believe in God. I'm also a teacher of science, and I must say I have never experienced any conflict between religion and science.

May I point you in the direction of Psalm 8. Here are a few verses:

Yahweh, our Lord,
how great your name throughout the earth!

. . .

I look up at your heavens, made by your fingers,
at the moon and stars you set in place –
ah, what is man that you should spare a thought for him,
the son of man that you should care for him?

The psalmist is acknowledging God's power of creation, not just of the earth, but of the heavens. The universe is God's creation, and all that it contains is His. He does not confine himself merely to our insignificant little world, beautiful as it is. I am certain that life exists on many other worlds, and that such life owes its being to God.

The Silly Season is over, but there are still those who would attempt to discredit religion, and teach us that science rules supreme. I can think of Professors Atkins and Dawkins, in particular. I for one would question their teachings, but then as a good science teacher that's my job.

Life may or may not have existed on mars. I'm certain we will find the answer to that question one day. However, one thing I am certain about, the Earth is but one small part of the whole unfolding universe – which is itself part of God's great creation.

David Williams

Reference:

The Jerusalem Bible, (Longman, 1968) ☆

FAS Convention

The Federation of Astronomical Societies organises an annual Convention in Cambridge. This year it was held on the 5th October, in the University's Cavendish Labs, just across the road from the Institute for Astronomy and the Royal Greenwich Observatory. I attended, partly as a delegate, and partly as a stand holder for *Eclipse99*. As usual there was a good collection of speakers, and about 200 delegates.

Dr Francisco Diego, a Mexican at the University College London, spoke on the subject of *Professional and Amateur Astronomy for the Public – Why and How?* His theme was knowledge for its own sake, and he started by emphasising ancient knowledge.

In 2,500 BC observations of the shape of the Earth's shadow on the Moon showed that the Earth was spherical. The Greeks measured the diameter of the Earth, and knew that the Sun was very distant. Galileo's *Sidereus Nuncius*, written in 1609, is still in print!

There is a wealth of organisations devoted to astronomy, including the popularisation of the subject. However, newspapers still concentrate on horoscopes. The United States has the largest number of planetaria and amateur astronomers, but still over half the population believes the biblical account of the creation of the universe.

Dr Diego urged astronomy society members to do more to popularise astronomy. The role of amateurs is important; they see real photons, whereas professional astronomers do not.

In a graphic demonstration he asked how we can explain a view like the Hubble Deep Field to the public. He suggested that we imagine 100,000 people in Wembley Stadium, each with a sack of rice containing one million grains. Using a grain of rice as a star, this would give the total number of stars in a galaxy. An area the size of the United Kingdom would contain just five grains! In an area of sky the size of Jupiter's disc there are 1500 galaxies, and in an area the size of the Moon's disc there are half a million galaxies!

This was an emotive talk to start the day.

The next talk was quite different. Dr Gerry Gilmore of the UK HST Facility, Cambridge, spoke about recent *ISO* (infra red) *images of the inner Milky Way*. He showed star formation regions close to the galactic centre, and concluded that, while only one in a hundred stars had been predicted to be young stars, in fact about half the stars were young. Therefore, it was necessary to have a fundamental change in our idea of the galactic centre.

The instrument cannot be used on any bright stars, as it would be damaged. Therefore Dr Gilmore said that, as we cannot look at anything we know about it was not surprising that we were finding new things!

A further unexpected discovery was the large number of dark areas where the infra red could not penetrate. Pictures of areas increasingly close to the galactic centre showed the huge concentration of stars within a few hundred light-years of the centre. The density of stars is ten million times that in the part of the galaxy in which our Sun exists. The stars near the galactic centre would be as close to each other as Jupiter is to the Sun!

The dark areas show that there remains a huge reservoir of material available ➡

for further star formation. This posed the question: where does this material come from? And is the Galaxy still growing?

Dr Gilmore finished his talk by showing the recently discovered Sagittarius Dwarf Galaxy, which is virtually invisible and close to the Milky Way galaxy. It is only 15 kilo-parsecs away from the centre – just twice as far as we are. When the galaxy was discovered there were news reports about its collision with our Galaxy, and Dr Gilmore had an anxious telephone call from an insurance company, asking if this was likely to result in huge liabilities!

After lunch, Dr Allan Chapman, of Oxford University gave a resounding talk entitled *The Cambridge Observatory and the discovery of Neptune, 1846*. This is a well-known story, but not the way Allan Chapman tells it! Despite the fact that there were concurrent tours of the Royal Greenwich Observatory and the Mullard Radio Astronomy Laboratories, about 150 delegates stayed to hear him.

And hear him they did – no microphone, and no notes, for a 1¼ hour performance filled with dates and facts. Dr Chapman is a flamboyant, larger than life character, embellished with bow tie, waistcoat, and double gold chain, undoubtedly with a fob watch on one end. I knew him by reputation as an astronomical historian, and in fact corresponded with him a couple of years ago, but I had never heard him speak.

He reminded us of the success of Newton's laws of gravitation in explaining the observed motions of the planets, but in the 19th century those laws were still under trial. Would planetary bodies actually move in accordance with Newtonian theory? After Edmund Halley, comets were fashionable, and, indeed, when Herschel discovered Uranus there was a suggestion that it was a comet rather than a planet. When Uranus did not follow exactly the path predicted by Newton laws, those laws were open to question. This problem was addressed by a 1928 report in George Biddell Airy, who was then at Cambridge. A better mathematical theory was required.

Allan Chapman theorised that a critical mass of published literature is necessary for great discoveries to be made, and that this often resulted in independent discoveries, sometimes in different parts of the world. He mentioned the independent invention of photography by Daguerre and Fox-Talbot, and the simultaneous discovery of anæsthetics on both sides of the Atlantic. He also emphasised the rapid communication which was possible in the mid-19th century, with the telegraph, ships and steam presses for printing.

John Couch Adams was not an astronomer, but a mathematician. The Cambridge Observatory had good observational data on Uranus, going back to the 18th century. Quite a lot of faith was placed in Bode's Law, which gave the expected distance of the possible unknown planet, and therefore its mass. Airy, by then Astronomer Royal, provided further data on Uranus, and, when Adams approached him (unsuccessfully) he asked Adams a number of basic questions: how had he calculated the mass of the planet, its distance, its velocity, etc.

Dr Chapman derided what he called "the Enid Blyton school of the history of astronomy", saying that a lot of rubbish had been written, and repeated, on the subject of the discovery of Neptune. He had gone back to the original sources, and was thus able to throw a more objective light on the subject. ➡

He recounted in detail the story of the observations in Cambridge, using the 12-inch Northumberland telescope (one of the biggest in Europe), the reasons why the Greenwich Observatory did not search for the planet (it had a six-inch telescope, and was an astrometric observatory, not for conducting what might be lengthy searches for planets which might or might not be there), the role played by Le Verrier, and the discovery with the 9.6-inch aperture Fraunhofer refractor in Berlin.

Dr Chapman concluded by describing the aftermath of the discovery, the anger of the Royal Astronomical Society, and the defence put up by Airy. He also emphasised the part played by Mrs Airy's complicated pregnancy and the arrest of Airy's assistant for incestial murder.

Quite a story, superbly told!

The next talk was different again. Dr Bob Thompson of the University of Hertfordshire spoke about *When Galaxies Collide*. He started by showing a clip from a 1950s film *When Worlds Collide*. He described the different kinds of galaxies: spiral galaxies, elliptical galaxies (which have little gas or dust), dwarf spirals and dwarf ellipticals, and active galaxies.

He made the point that whereas stars are small compared to the distance between them, galaxies are large compared to the distances between them. Therefore, when galaxies collide the stars themselves do not collide. However, the stars do interact gravitationally. This all takes place in slow motion; it takes 10 to 100 million years for galaxy interactions.

He showed pictures of the Whirlpool Galaxy, which can possibly be explained as a passing galaxy, drawing stars off another. He also explained the appearance of the Antennae Galaxy (possibly due to merging galaxies), and the Cartwheel Galaxy (one galaxy passed through the middle of another one). These were demonstrated by videos of computer simulations. He emphasised the importance of dark matter; the luminous stars "slosh around" within a sea of dark matter.

Dr Thompson described observing quasars as like trying to observe someone standing in a dark room shining a torch in your face.

He concluded a fascinating talk by discussing the subject of galaxy evolution as demonstrated by the Hubble Deep Field. This is an image of what appeared to be a black bit of the sky taken over 150 orbits during 10 days last Christmas. It revealed a multitude of objects, only about ten of which were stars; the rest were galaxies. The brightest star in the Field is 20th magnitude (about a million times fainter than the faintest naked eye star), and the faintest objects are 30th magnitude! 250 objects in the Field have been classified, and about 150 redshifts determined.

At a redshift is 1 the universe was about 40% of its present age. Beyond that redshift there are more peculiar galaxies. He showed another field with galaxies redshifted to 2.9, corresponding to just 20% of the universe's age. This showed faint blue dwarf galaxies, which may be sub-galactic clumps which merge together to form galaxies.

Dr Thompson said that, because of the success of the Hubble Deep Field, another HST Deep Field (HDF2) is to be taken in the southern hemisphere. Who knows what this may reveal!

The final talk of a most interesting day was by the Astronomer Royal, Professor Sir Martin Rees of Cambridge University. ➡

The title of his very well structured talk was *New Light on Dark Matter*. He started by showing the well-known poster of the Earth from space at night, and pointed out that our interpretation of the Earth, based only on such a view, would be biased. The same applies to our knowledge of the universe based on observations in visible light. There is no reason why everything in the universe should be visible, any more than everything on Earth is visible.

He showed images of the Milky Way in visible, radio, microwave, infrared and x-ray radiation, demonstrating the quite different views given. Even observing at all these wavelengths we are probably missing a lot. The 21-cm line shows the existence of gas around the Andromeda Galaxy, and others, and the orbital velocity of the gas, determined by the Doppler effect, is found to be uniform with distance from the centre of the galaxy. The gas in the outside regions of the galaxy must therefore be affected by dark matter, because, in accordance with Newton's theory, a shell of material affects what is inside it, but not what is outside.

There is similar evidence for dark matter in clusters of galaxies. In all, it is inferred that there must be ten times more mass than that which is observed. Recently, gravitational lensing (caused by the bending of light around massive objects) by clusters of galaxies also shows the existence of dark matter, corroborating other evidence

Oh dear (he might have said), what can the matter be?

Options include: *faint stars* (dead ones or ones too small to shine). Apparently, these can also produce gravitational lensing, and about eight such events have so far been observed. Possibly about 10% of the dark matter in our galaxy could be explained in this way.

WIMPS (weakly interacting massive particles, which have no electric charge but have some mass). We orbit the galaxy at a speed of about 200 km/sec. Such particles would orbit at about 300 km/sec. There could be 100,000 particles per cubic metre. One cubic kilometre contains 10^{27} atoms, but only one collision per day is expected. Detection is, therefore, difficult, but attempts are going on in the Boothby Mines in Yorkshire, amongst other places.

Diffuse gas between us and other galaxies and quasars.

Professor Rees then turned to the subject of cosmology and dark matter. The critical average density of the universe is about 5 atoms per cubic metre. All the luminous matter gives an average of 0.1 atom per cubic metre (equivalent to one snowflake in a volume the size of the Earth!). Adding into this the dark matter inferred by what we can see gives a factor of ten. But this still reaches only 1/5th the critical density.

There are three lines of attack to determine what dark matter is: direct detection, progress in particle physics, and simulations of galaxy formation.

The values of Hubble Time vary between 12 and 18 billion years, the oldest stars being about 12 billion years old. There is a problem if the universe is at critical density. If the Hubble Time is short and the universe has high density then there is a big problem. Therefore, a short Hubble Time argues against a critical density. However, consensus is being reached on a relatively high value for the Hubble Time.

Professor Rees gave the opinion that ➡

these questions were likely to be answered within five years.

He concluded by graphically pointing out that even if the critical density is not reached, an "everlasting" universe could not last for ever, because of factors such as proton decay, and he gave estimates of the time taken for the universe to die, based on a variety of scenarios. Chilling stuff!

I can certainly recommend the FAS Conventions to members. At just £4.50 per ticket for such superb speakers it is excellent value, and, of course, you also get to meet many amateur astronomers from all over the country.

In addition to attending the lectures I was manning a stand for my Company, *Eclipse99 Ltd* (with considerable help from my daughter, Sarah), selling solar viewers and filters for the next week's eclipse. Despite a poor position (up two flights of stairs), we did fairly well, and there was much interest from delegates. Going particularly well was the new book by Dr Steven Bell of HM Nautical Almanac (Royal Greenwich Observatory), just published by HMSO, *A Guide to the 1999 Total Eclipse of the Sun*, which includes colour plates and a free eclipse viewer.

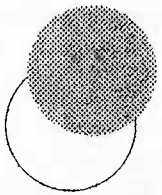
I also set up a small stand for the Astronomy Section, showing some of our photographs and publications, and many people stopped to have a look.

Although Cambridge is quite a way from Guernsey, it is well worth the trip. I combined it with a meeting with Steve Bell at RGO (about his book and the Royal Astronomical Society conference in Guernsey in 1999), and a meeting with Sheridan Williams, who wrote the book *UK solar Eclipses from Year 1*.

David Le Conte

Solar eclipse magnitudes

What is the basis for the calculation of the "magnitude" of a solar eclipse? Most software that I have seen calculates the magnitude as the fraction of the **diameter** of the Sun which is covered by the Moon. That sounds reasonable enough. But the Society for Popular Astronomy's web page on the recent eclipse gave magnitudes based on the **surface area** of the Sun which was covered by the Moon. That seems more reasonable.



In *A Guide to the 1999 Total Eclipse of the Sun*, Steve Bell uses the **diameter to determine magnitude** (and points out that this can be greater than 1, if the apparent diameter of the Moon is greater than that of the Sun), and the surface area to determine **obscuration** (which cannot be greater than 1). This seems to be a good distinction.

But, given the *magnitude*, how does one calculate the *obscuration*?

We assigned this problem to Peter Langford, who soon came up with a method, leading to the formula:

$$\text{Obscuration} = 2(\alpha - (1-a)\sin\alpha)/\pi$$

where a is the fraction of the diameter of the Sun's disc covered by the Moon, and:

$$\alpha = \cos^{-1}(1-a) \quad \text{in radians.}$$

Using this formula, we find that the solar eclipse of 12 October, which had a *magnitude* of 57.7% as seen from Guernsey, had an *obscuration* of 47.8%. Note, however, that this formula assumes that the solar and lunar discs have identical diameters.

David Le Conte

Millenium projects

Two projects have been submitted on behalf of the Astronomy Section. The first is a **camera obscura** for the top of Castle Cornet. This is a periscope-like device which uses a mirror and lens at roof-level to project an image of the landscape, usually onto a large, horizontal screen, like a circular table. In the past they have also been used to assist artists to draw pictures, for photography, and for celestial purposes. These days they are mainly used as tourist attractions. Visitors can stand around the table, viewing a panoramic landscape as the projection system is rotated.

Examples may be seen in Mont St Michel, Edinburgh and Aberystwyth, amongst other places. We think that Castle Cornet would be an excellent place for such a device, as it is in an elevated position commanding superb views of the other islands, the Harbour and the Town.

The camera obscura could be put in one of the existing buildings on the Castle, or, if another Millenium proposal – to rebuild the ancient donjon (tower) – is approved, then it could be installed at the top.

The second project is a **major new telescope** for the Astronomy Section Observatory. What we have in mind is a 16-inch Meade telescope, to be installed in the existing building. Such an up-to-date instrument would be fully computerised, with its own database of objects, and with the ability to point to any of them at the touch of a button. The cost would be of the order of £16,000.

In the application we have stressed the fact that the Observatory and its equipment are not just for the use of Section members, but constitute a facility for the island community and its visitors. This year, for example, several hundred people have visited the Observatory, looked through our telescopes, experienced something of the wonders of the night sky, and, hopefully, gained a better understanding of the universe.

The new telescope would enable us to improve our observational work, and provide a better instrument for visitors to the Observatory, giving them a better opportunity to see objects, especially the fainter ones, which currently take us a long time to acquire in the field of view.

We have also pointed out that the Royal Astronomical Society is holding its major conference here in 1999, and that it would be good to have a modern-equipped observatory.

A third project has been submitted by myself. This is a **model of the solar system** to be distributed over the whole Island, to the correct scale, both in size and distance of the planets from the Sun. Each object could be depicted in stone, or some other durable material, and they would be positioned in precise positions representing the actual positions of the solar system objects at the moment of the dawn of the Millenium – 00 hours, 00 minutes, 00 seconds on the 1st January 2000 AD.

People interested in this facility could visit each object in turn, travelling from one to the other. It would give them a graphic impression of the scale of the solar system.

Details have not yet been worked out. However, at the largest possible scale, Jupiter would be about 450 mm diameter, the Earth would be 40 mm diameter, and the Sun would be over 4 metres diameter.

David Le Conte