## Open Sesame

Owing to the need for greater security, now the new telescope is in its place, it was decided to remove the key of the Observatory from its secret hiding place.

There are now designated key holders to the Observatory building. Names and numbers appear below.

| | |
|---|---|
| Peter Langford | 720649 |
| Paul Gavey | 726645 |
| Charlie Vining | 254172 |
| Geoff Falla | 724101 |
| Jessica Harris | 247193 |
| Debby Quertier | 725760 |
| David Le Conte | 264847 |
| Roger Chandler | 237367 |
| Frank Dowding | 255215 |

## New Facilities

Charlie Vining has installed a motor to replace the hand winch to slide back the Observatory roof, which is a great improvement. David Le Conte has linked the computer in the Observatory to the new Meade telescope. You can point at a star on the map on the computer screen and the telescope goes and points at it. Frank Dowding has installed a telephone extension in the Observatory. Come along and see the new facilities any Tuesday evening.

## Double Summer Time

If Double Summer Time is introduced sunset will be an hour later, which may have an adverse affect on astronomers. If you have any views please contact David Le Conte.


Astronomy Section Officers

| | | |
|---|---|---|
| Joint Secretary | Jessica Harris | 247193 |
| Joint Secretary | Debby Quertier | 725760 |
| Hon Treasurer | Peter Langford | 720649 |
| Editor | Peter Langford | 720649 |
| Facilities | Geoff Falla | 724101 |
| Public Relations | David Le Conte | 264847 |
| Imaging | Daniel Cave | 264415 |
| Research | Frank Dowding | 255215 |
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# Sagittarius


The Newsletter of the Astronomy Section of La Société Guernesiaise

***July - September 2000***


## Forthcoming events

***BBQ and Perseids Meteor Count***
**Friday, 11th August**
7.30 pm at the Observatory
*(Bring the family)*

***Looking for Encke's Comet***
**Tuesday, 5th September**
8 pm onwards at the Observatory

***Slide Show***
**Tuesday, 24th October**
7.30 pm at La Hougette School
followed by viewing at the Observatory

In addition, the Section meets at the Observatory every Tuesday evening, and Friday if clear for observing.

## In this issue

Our Incredible Universe
In the Beginning
Sir Isaac Newton

## Inside



## Centre inserts

Star chart
Moon phases
Sunset and sunrise times

## Messier Marathon

*In 1784 French astronomer Charles Messier produced a catalogue of objects which appeared fuzzy in a telescope. They have been popular objects for astronomers ever since. For a short time in each year it is possible to view all 110 Messier objects during a single night in a "Messier Marathon". **Debby Quertier** describes the Section's attempt to complete the Marathon this year.*

Our attempt at a Messier Marathon was originally scheduled for the 1st April. The date was chosen firstly because there was no Moon, secondly it was a Saturday night and we could lie in on Sunday. Unfortunately the weather was about as bad as it could get and there was no chance of seeing anything. We rescheduled to the 8th April. Although the Moon would be a few days old it was the only practical date left until next year. Luckily the weather was good that night and things looked promising. We had done some research on the subject and several astronomy publications had lists of the best order to view. The lists varied in their order only very slightly and we knew that the doubtful objects would be those at the start of the session and those at the very end.

*we knew that the doubtful objects would be those at the start of the session and those at the very end.*

We started looking at around 9 pm. The sky was not completely dark and the youngish Moon was getting lower in the west. The first half dozen objects were galaxies in Cetus, Andromeda, Pisces and Triangulum. These proved to be too low down in too light a sky, though we did spot M31 and M32, the great spiral and elliptical galaxies in Andromeda. The next few objects were clusters in Cassiopeia, Perseus and Taurus, which were not too difficult, and of course M45, the Pleiades, which does not require any optical aid whatsoever. M76, a planetary nebula in Perseus and the faintest Messier object, commonly known as the Little Dumbbell because of its shape, was surprisingly clear for a 12th magnitude object. Number 12 on the list, M79, a globular cluster in Lepus, was too low to be seen, but after this it was easy to see the nebulæ in Orion and the clusters in Auriga, Gemini and Monoceros. We could not see M41, an open cluster in Canis Major, because a large tree was in the way. We had not bargained for that and if we attempt the Messier Marathon again we should maybe try to see this object earlier in the viewing. After M41 each object to which we turned the Meade telescope was there in the eyepiece. We went through Puppis, Hydra, Cancer, Ursa Major, Leo, Canis Venatici, Coma Berenices, Virgo, Hercules, Ophiocus, Lyra and Cygnus. We saw many galaxies, in particular the many galaxies in Virgo, and noted the many different shapes from spirals to irregular. We saw the difference between face-on and edge-on ones. Some objects had noticeably bright cores whilst others were just visible as hazy smudges. There were many differences between the globular clusters we looked at. On the one hand there was M13 in Hercules, which is always a wonderful sight, and M80 in Scorpius, which did not really stand out as an obvious globular cluster. We were generally pleased with what we saw and with how many individual stars that could be resolved in the eyepiece. We also looked at M57, the Ring Nebula in Lyra, using a higher power and this was most impressive.

After about 1 pm the sky started to get a little hazy and we were not seeing very well through the Meade telescope. We soon got over this little hitch when we realised that the telescope had dewed up - nothing that a bit of warm air from the hairdryer could not deal with. Once the dew was cleared viewing was fine again. However, after about 3am the sky got worse and by the time we looked at M27, the Dumbbell Nebula, the sky was hazy and the dew was heavy. M27 was just a smudge, the shape that gives it its name not at all clear. It was the last object we saw as mist, haze and cloud beat us. Around 4am we called it a night.

Well, we did not complete a Messier Marathon, and anyway you are supposed to find the objects manually rather than use a computer-controlled telescope. Nevertheless it was a useful exercise and helped us learn the capabilities of the new Meade telescope. Each object we told it to go to was there in the eyepiece every time. We saw a total of 78 out the 110 Messier objects, with the bonus of several NGC objects which fell in the fields of view. Some of the Messier objects were disappointing, one or two of the open clusters were nothing special, but the vast majority were well worth seeing. There was such a diversity of objects and hopefully we improved our skills as observers.

Several of us were there at the start of the evening and stayed until midnight and three stayed until 4am. It has got to be worth having another go next year, trying to find the objects with the C11 and C14 telescopes as well as with the Meade. Suitable future dates are 24th March 2001 and 16th March 2002. As one of those who stayed until 4am I can say it was fun and well worth doing.

***Debby Quertier***

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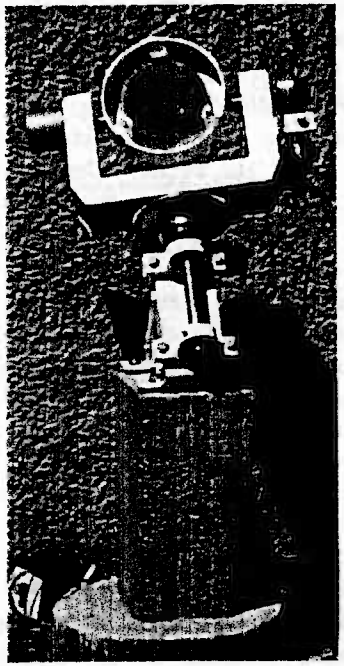
## Solar Observing

Frank Dowding, David Le Conte and Geoff Falla displayed hitherto unsuspected skills as manual labourers to construct a concrete support on which to mount a coelostat. This device was used last year in Candie Gardens in the run up to the solar eclipse to project an image of the Sun onto a screen. Mounted on its new stand at the Observatory the coelostat mirror reflects the Sun's light onto a fixed mirror some distance away. A motor drive on the coelostat rotates the mirror as the Sun moves to keep the Sun's light reflected onto the fixed mirror. That mirror reflects the Sun's light through the Observatory window and projects an image of the Sun onto a screen inside.

The coelostat was put to the test on the Section's Solar Observing Day on the 18th June. Fortunately it was a clear day and we had a nice projected image of the Sun, showing a dozen or so sunspots.

With the aid of special solar filters, so as not to damage our eyes or the instrument, we also viewed the Sun through the telescope which revealed the structure of the sunspots in some detail.

***Peter Langford***



Coelostat mounted outside the Observatory

# Pluto

***Debby Quertier** reports on the search for the elusive planet.*

On Tuesday 6th June we searched for the planet Pluto using the new Meade telescope. Pluto is the smallest and most distant planet in the Solar System, and a challenge to observers. However good your skies are you need a fairly large aperture telescope to see it, as well as detailed star maps, down to about 15th magnitude. Seeing Pluto is within the capabilities of both the C11 and C14 telescopes. However, the computer-controlled Meade telescope had the great advantage that it took us straight to the right part of the sky. From the star maps we had, together with the one loaded onto the computer linked to the Meade in the observatory building, we saw there was a magnitude 8 star in the centre of the field and that Pluto should be around about twelve to one o'clock above it. It took a fair amount of looking before we finally spotted the elusive ninth planet, mainly seen with averted vision. It was very faint and could easily have been missed but the maps were good and it was where we expected it to be. I think I can speak for all of those of us who saw it and say that we were thrilled to bits to have seen Pluto.

Three of us stayed on at the observatory, looking at various objects, and some time after 1am we looked at Pluto again. It was a little easier to see then. By this time the sky was pretty good, with the structure of the Milky Way visible. Neptune was also looked for and found, visible as a tiny disc.

I had started off that evening by scouring the horizon to find Mercury, which was almost at greatest elongation. It was around ten o'clock before I managed to spot it. There was a lot of cloud in the way but Mercury was quite low down. Even though it can be quite bright once you eventually spot it, it is not an easy planet to find. I had started the evening seeing Mercury, the nearest planet to the Sun, and in the early hours ended by seeing Pluto, the farthest planet from the Sun. Having also seen Neptune that evening I have now seen all the planets of our Solar System in the new telescope. I do not know if we would have been as successful with the C11 or C14. The Meade certainly made it easier. Even so, Pluto is not an easy object to spot, even with a sixteen inch telescope and a clear night.

***Debby Quertier***

# Sir Isaac Newton

## by Frank Dowding

Isaac Newton was born on December 25th, Christmas Day, in 1642. He was born prematurely and his father had died two months earlier, on October 6th. It was not a very good start in life but there was worse to come. His mother, Hannah, remarried when he was three years old and went off, leaving Isaac with his grandmother. All this happened in Woolsthorpe, Grantham, Lincolnshire, where the house still stands to-day.

His grandmother sent Isaac to school in Skillington when he was five years old and later to Kings School in Grantham. In 1653 the man Isaac's mother had married, a Rev Barnabas Smith, died and his mother returned. The first thing his mother did was to take Isaac, who was now eleven years old, away from school because she wanted him to be a farmer. Isaac did not want to be a farmer and had no interest in the farm he was sent to.

It was at this stage that things started to get better. The headmaster of Grantham School knew that Isaac was talented and, with the help of Isaac's uncle, William Aysgough, they persuaded his mother that Isaac should be prepared for university. He entered Trinity College, Cambridge, on July 5th, 1661, at 19 years old. Four years later he achieved a BA for his studies in mathematics. At age twenty six he became a Major Fellow of Trinity with a Masters degree and a Professorship.

Between 1666-1672 he lectured about his mathematics, which included calculus, binomial expansion, algebra, number theory, analytic geometry, finite difference, classification of curves and probability. He often said that he had learned a lot from Descartes and Wallis. In 1687 Isaac Newton completed his 'Principia', a superb collection of a mathematical genius and a work which underlaid the theory of universal motion.

In 1705 Sir Isaac Newton was knighted for the greatest mental effort ever made by man. He died on March 20, 1727. He was buried in Westminster Abbey and a statue to him was erected at Trinity College Chapel.

***Frank Dowding***

# DR LAWRENCE PILKINGTON, 1911 - 2000

Dr Lawrence Pilkington, who died on the 11th March, was a valued friend and benefactor of the Astronomy Section. As a retired Chairman of the Optical Division of the Pilkington Glass Company, of which he was, of course, a family member, he had both a personal interest and a professional one in astronomy, especially the instrumental aspects. Even in his retirement he consulted on major telescope projects on both sides of the Atlantic.

Dr Pilkington was noted for his generosity, and support for a variety of charitable interests. In the 1980s he assisted with the purchase of the Section's 11-inch Celestron telescope, and he then lent, and later donated, his own 14-inch Celestron and accessories, which he had moved from his villa in Portugal, where it had also been used by an astronomy society. He also donated some of his books to the Section's library.

The acquisition of the 14-inch in 1993 stimulated us to construct the telescope building, as we realised that such an instrument was worthy of a home of its own, and required a permanent pier. Regretfully, he did not make much use of it himself after it was housed at the observatory, and in recent years we saw little of him, although he continued to live at the top of Colborne Road. Despite his age, however, he appeared always to be most sprightly, hopping in and out of his large four-wheel drive vehicle.

He frequently urged us to use the latest electronic and optical technology, especially instruments such as image intensifiers. I recall him relating how, in the 1940s, he had developed such a device, which he demonstrated one night to the Army by driving two officers at 60 mph through narrow Welsh lanes in the pitch black, with the car lights off, scaring the officers almost to death!

He also taught us not to be afraid to think big. I would like to think, therefore, that he would have been pleased to see our latest developments. Unfortunately, he died the day after the unveiling of the new telescopes, which he was, of course, unable to attend.

With the death of Dr Pilkington, the Astronomy Section has lost a valued friend, who showed us considerable support at a time when we were venturing into the creation of a proper observatory. Without his help it is doubtful that we would have achieved so much.

***David Le Conte***



# In the Beginning

*Taking his theme from Genesis chapter 1, verse 1,* ***David Williams*** *examined the traditional arguments for the existence of God and the interplay between science and religion in his talk to the Section on 16 May*

For centuries there was no doubt in the mind of the common man in the Christian world that God existed. It was an unquestioned article of faith which provided comfort and security. Nevertheless, at various times attempts have been made to supplement this faith by proofs of the existence of God. The proofs have been along three main lines; the ontological argument, the cosmological argument and the design argument.

The first of these, the ontological argument, attempts to prove the existence of God by pure logic and reason. It starts by defining God. God, the definition goes, is a being than which nothing greater can be imagined. The argument is then that, since everyone can imagine a greatest thing, God exists. The major flaw in this line of reasoning is that such a being may be said to exist but it may exist only in the imagination. One might imagine a perfect island but imagining it does not mean it exists in reality.

The second type of proof, the cosmological argument, has several variants including one put forward by Thomas Aquinas. It postulates that events come about by a chain of causes. The Universe exists today so something must have caused it. Something prior to that must have caused what was there before, and so on back in time. At some point, the argument goes, you must reach a first cause which was not caused, and God is that uncaused cause.

The argument relies on the Universe having a beginning so it loses its force if the Universe has existed for an infinitely long time. It also assumes that events are deterministic, so one thing necessarily follows another, which is at odds with the apparent randomness observed at the quantum level. However, if we accept the Big Bang theory, with time, space, energy and matter all appearing some 12 to 15 billion years ago, then it may be argued that it was God who set it all going. The argument is perhaps even more appealing given the unexplained very fine tuning between the fundamental forces of nature which allow us to exist at all.

One problem with the chain of causes argument, even if it is accepted, is that it only establishes a God who set things going at the start. After that He could just stand back and watch His creation without any further intervention.

The third main argument for the existence of God is the design argument. Not coincidentally this line of reasoning was promoted at around the time of the Industrial Revolution when people were creating ingenious new inventions. It was argued that the difference between a watch and a stone is that a watch has

order, complexity and purpose. A watch is also the product of an intelligent designer. The argument goes that anything which displays a high degree of complexity, order and purpose must necessarily have a designer. The works of nature have order and complexity and are suited to their purpose so a designer must exist. That designer is God.

Nowadays we have a much better understanding of how complex, ordered systems can evolve from simple components without external intervention. Consequently the necessity of a designer, which is crucial to the argument from design, is called into doubt.

*What Copernicus and Galileo did was to actually test the ancient theories by making observations. They found the old theories did not stand up.*

Having given us a brief review of the traditional arguments for the existence of God, David went on to look at the role of Copernicus and Galileo and the rise of science. Copernicus and Galileo did not necessarily doubt the existence of God but they were interested in finding out how His creation actually worked. Up until that time the accepted view was that the workings of the Universe had all been explained by Aristotle and others in ancient times. What Copernicus and Galileo did was to actually test the ancient theories by making observations. They found the old theories did not stand up. For example, the observations of the movements of the heavenly bodies could not properly be explained if everything orbited the Earth but they could be if the planets orbited the Sun. The publication of these views eventually brought Galileo before the Inquisition and he was forced to recant. However, Galileo's notion that we should carefully observe how things really work was irrepressible and is the basis of a scientific revolution that continues to this day.

Science of course can never prove anything. All theories are provisional and represent the current best attempt to explain known observations. Theories can be found inadequate and have to be abandoned if what they predict is at variance with what is observed. Science advances by actively seeking observations which test current theories. Reflecting on David's talk it strikes me that the traditional arguments for the existence of God are essentially attempts at establishing a scientific proof. Since science cannot positively prove anything such arguments are consequently doomed to failure.

On the other hand disproving something as intangible as God is probably beyond the reach of science so science and religion should be able to coexist. However, as history has shown, science is not a comfortable bedfellow for religion. The thrust of science is to find a natural explanation for events so, to the extent that it is successful (and so far science has been phenomenally successful), it leaves less and less room for the supernatural. If religion makes any assertions about the world that can in due course be tested by observation then, sooner or later, those assertions are likely to be challenged and, as theories are tested and refined, shown to be in some way to be false.

As David concluded in his talk, our ignorance is profound and the more we know the more we find there is to know.

***Peter Langford***

Further reading: "Galileo's Daughter" by Dava Sobel



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## Astronomy and Space - References for further reading

***compiled by Geoff Falla***

**Planetary Conjunctions.** The grouping of planets in major conjunctions, often seen as omens, and some of the associated events of world history. *Sky and Telescope, May 2000.*

**Galaxies - The Hubble Sequence.** The classification of galaxies by Edwin Hubble. How modern observations and photography have affected earlier concepts. *Sky and Telescope, May 2000.*

**Optical Search for Extraterrestrial Intelligence.** The SETI programme, using radio telescopes at Arecibo and Jodrell Bank, has now been joined by another technique - the search for laser signals using optical telescopes. *The Planetary Report, March/April 2000.*

**Arthur C Clarke.** Interview with the renowned author, now living in Sri Lanka, originator of the concept of geosynchronous satellites for worldwide communications. *Quest and Astronomer Magazine, Issue 1.*

**Hubble's Tenth Birthday.** A summary of some of the major achievements of the Hubble Space Telescope since its launch in 1990. *Astronomy Now, May 2000.*

**A - Z of Astronomy.** A detailed 16 page guide, providing an easy reference explanation of over 400 astronomical terms, from aberration of light to zodiacal light. *Astronomy Now, May 2000.*

**The Planisphere.** The inexpensive and very useful device for indicating a window area of sky, and the position of constellations at any time of the year. *Astronomy Now, May 2000.*

**Celestial Mechanics.** The story of three famous astronomers, Nicolas Copernicus, Tycho Brahe and Johannes Kepler, who discovered and refined the laws of planetary motion. *Astronomy Now, May 2000.*

**Cometary Origins.** From comets once seen as bad omens, some of the secrets of these icy wanderers of the Solar System are slowly being revealed. *Astronomy Now, May 2000.*

**Auroral Storm seen from Britain.** An extensive auroral display was seen throughout the British Isles (including Guernsey) on the evening of April 6th. Some stunning and unusual photographs were obtained. *Astronomy Now, June 2000.*

**The Milky Way.** A summary of what is known about our own galaxy of stars, its shape size and composition. *Astronomy Now, June 2000.*

**Solar System - The Planet Hunters.** Three articles describing the search for and discovery of the the most distant planets, Neptune and Pluto, and some evidence that others may yet exist in the inner and outer reaches of the Solar System. *Astronomy Now, June 2000.*

**Leonid Meteors.** Several major articles on the subject of the Leonids. The meteor storm of November 1999, and Leonids seen impacting the Moon's surface. The meteor peak may yet be exceeded next year or in 2002. Predictions of the two astronomers who accurately predicted last year's Leonid peak. *Sky and Telescope, June 2000.*

**Mercury.** Some of the early recorded observations of the planet Mercury, which has been visited by only one spacecraft to date, and is still largely unmapped. *Sky and Telescope, June 2000.*

**Near Earth Asteroids - Eros.** The NEAR (Near Earth Asteroid Rendezvous) spacecraft Shoemaker has arrived at Eros. Current investigations of the asteroid from low altitude orbit, with photographs taken from a range of just 60 miles. *The Planetary Report, May/June 2000.*

**Mir Space Station.** The Mir Space Station is back in business. Left unmanned for a while, a new plan is underway to boost its orbit by attaching a long cable. *Astronomy and Space, June 2000.*

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## Some of the Wonders of Our Incredible Universe

*On Friday, 30th June **David Le Conte** gave a talk to the Meeting Point series at the Town Church*

When the Rector, John Elliston, asked me talk about the wonders of the universe, I was delighted but rather apprehensive. Pleased at the honour of being asked back for a second time and being given such a general topic that I could choose to speak about almost anything, but then uncertain as to how to do justice to such a far-ranging subject in less than half an hour. I concluded that it would be best to give you an account based largely on my personal experiences, and try to impart some of my own wonder at the universe and what it contains.

Then a couple of weeks ago I came into the Church to check on the exact wording of the title which the Rector had given to this talk, so that I could be sure that it bore some resemblance to what was expected of me, and I was struck by his very careful choice of words: Some of the Wonders of Our Incredible Universe. But I shall come back to that later. But I am pleased that he included the words "some of"!

As one grows older, and with increasing understanding of the world, one might expect one's sense of wonder to diminish.



But I find that as I grow older the more wonder I experience, partly, perhaps, because of increased knowledge, but also because I realise the multitude of things I don't understand.

Whereas once I took for granted the existence of the Earth, the visible contents of the celestial sphere, the evident fact of life, and indeed my own existence, I now marvel at these phenomena. I marvel that I exist at a time when the evolution of the world has reached a point of high sophistication and complexity, where the Earth is filled with a diversity of not just thousands but millions of species of plants and animals, where there is so much beauty created by millennia of geological development, where human history has reached the point when technology has contributed to a comfortable life for many, and where the arts and sciences flourish. I marvel at my very existence at this exciting time, when I could perhaps have been born in a different century, a different country, or perhaps not born at all. And I am thankful to have a place as beautiful and as stable as Guernsey to call my home.

It need not, of course, have been thus. I was born into a world in the turmoil of war, uprooted at the age of just three months to be evacuated to England as our Island was occupied. But by the age of five, things started to return to normal, stability returned, and for me they have remained fairly normal for most of my life.

But perhaps most extraordinary of all is the fact that the studious dedication of so many people, living and dead, has led to a deeper understanding of what we see around us. In my own lifetime we have been increasingly able to interpret the world's physical and human development, pre-history, archaeological evidence, the functions of the human body, and the delicate balance of the Earth's biosphere. And we have even, in my lifetime, obtained our first view of the Earth from space. The Earth is a beautiful sight, and rivals anything we see elsewhere in the universe. The picture also vividly shows us that we are ourselves a part of the universe, floating through space on a fragile planetary body, with a thin surface biosphere and a barely discernible atmosphere on which all our lives depend.

There is, however, a wealth of natural phenomena to which many people, even today, are oblivious. Many years ago, as a teenager, I acquired a book called "Light and Colour in the Open Air" by the Dutch Professor M Minnaert. This book has been a constant companion throughout my life, and has opened my eyes to many atmospheric effects which are all around us, there to be seen, but which most people probably spend a lifetime never having observed. We have all marvelled at a rainbow, but how many people have noticed the reversed colours in a double rainbow and the marked difference in luminance of the sky between the bows, Sun Dogs and haloes around the Sun and Moon caused by ice crystals in the upper atmosphere, watched for the occasional Green Flash at the setting of the Sun, observed the striking "Glory" of coloured light fringes around the projection on mist of one's own shadow or perhaps the shadow of the

'plane one is travelling in, the moving dark bands created by the vertical bars of motorway bridges, and a myriad other fascinating visual phenomena?

But my own sense of wonder has long extended far beyond the Earth and its atmosphere. Indeed, I can remember the exact moment I became aware of the cosmos: 6.00 pm on November 5th, 1946. I was six years old and celebrating my first Guy Fawkes Day here in Guernsey, on a brilliant star-lit night. During World War II, of course, there had been strict blackouts - bonfires and fireworks were out of the question.

As, for the very first time, I watched rockets shooting up from the back garden, I asked the adults present how high they went. "Very high" was the unsatisfactory answer. "Higher than the trees?", I asked. "Yes! Look at them go way above the trees." As high as the stars?" "Oh, well no, not as high as that!" "Well, how high are the stars?" I learned then that adults do not know everything, and that there was a mystery in the night sky up above our own garden. That experience led to a lifetime exploring this mystery, and decades of intense pleasure at discovering the myriad varieties of objects which the universe contains.

*That experience led to a lifetime exploring this mystery*

Just as atmospheric phenomena can be seen by naked-eye observation of the daytime sky, so observation of the night sky, even without any optical aid, reveals a host of celestial bodies. At any one time we can see some two thousand stars, and even a casual view shows, not just familiar stellar groupings of constellations, but also that some stars are brighter, some fainter, and that while most stars appear white, some are distinctly reddish or bluish in colour. And on a clear, dark night the bright path of the millions of stars making up our galaxy, which we call the Milky Way, is clearly visible.

But there are many other objects. The most obvious of these are the Moon and the planets, which, along with the Earth, orbit the Sun in our Solar System. The phase changes and motion of the Moon are probably familiar to all of you, and the Moon's unique relationship with the Earth and Sun was dramatically demonstrated by last year's total solar eclipse. But I am constantly surprised that most people are not aware of planetary motions, and many have probably never confidently identified a planet, five of which are easily seen with the naked eye. If you are an early riser (4.00 am!) you can see Jupiter and Saturn now, for example, in the east before sunrise, close together, with Jupiter being the brighter.

The planets are the Earth's companions in space, but the lack of common understanding of their motions leads to the kind of uninformed public and media reaction which we experienced just a few weeks ago, when they came together in a planetary conjunction. Part of the blame for such ignorance must lie with modern lighting



practices and other distractions, which have meant that man has increasingly lost touch with the visible universe. But I am concerned that many people seem to be attracted to superstitious explanations for what are simply natural phenomena. For me there are quite enough natural wonders, without having to invent new supernatural ones.

A few years ago we all marvelled at Comet Hale-Bopp, as it made its unheralded visit to our part of the solar system. Meteors or shooting stars are more regular visitors to our night sky, and man has added to the visible objects by launching satellites, several of which you can spot on any clear night.

*some of the most fascinating objects are other galaxies*

With a simple pair of binoculars you can see many more wonders. You can clearly see craters and mountains on the Moon. Point your binoculars towards Jupiter and you will just make out four of that planet's moons discovered by Galileo in the early 17th century. Look again the next night and their positions will have changed, as they circle the planet. Look at the star Alcor in the Plough, and you will clearly see that it is actually two stars which are in a slow orbit around each other. And sweep your binoculars across the Milky Way, and you will be struck by the many thousands of stars which spring dramatically into view.

Just above Jupiter there appears a tight grouping of stars, which is clearly not a constellation. The Pleiades is a cluster of young stars, and with binoculars you can see some remnants of the cloud of gas from which they were formed.

But then, with our binoculars, and even more with a telescope, such as the magnificent instruments we now have at the observatory of La Société Guernesiaise, we start seeing objects which are clearly not stellar in appearance. The Messier chart shows over a hundred of the brightest and most interesting of these objects. It includes dense, globular clusters of thousands of old stars, huge glowing nebulæ of hydrogen gas and dust which are stellar nurseries where new stars are being born, rings of light which turn out to be the remains of stars like our own Sun, and the faint gaseous remnants of supernovæ - hot, massive stars which exploded in historic times or many thousands of years ago.

All of the objects which I have so far mentioned are in our own galaxy, lying within a few hundred or thousand light-years, and these summer months are particularly interesting for us in Guernsey, as we can see low in our southern skies the central region of our galaxy, with a host of star clouds, and gaseous nebulæ.

But some of the most fascinating objects are other galaxies, millions of light-years away from our own. These typically contain 100 thousand million stars, and there could be as many as 100 thousand million such galaxies in the universe. Some have beautiful spiral forms, which we see face-on, edge-on or in perspective. Our galaxy, the Milky Way, is one of a group of some 20 such galaxies, but there are clusters containing hundreds or thousands of them.

Massive telescopes, and the Hubble Space Telescope in particular, reveal many galaxies which are otherwise invisible. Two remarkable pictures, called the Hubble Deep Fields taken by the Space Telescope of tiny and apparently void areas of the sky, over a period of ten days, show thousands of galaxies so faint and remote that they cannot be seen by any other means. We can safely assume that the whole of the universe is pervaded by galaxies which we do not see. And we are aware that the universe itself is expanding, as if it was formed out of a giant explosion some 12,000 million years ago, which we refer to as the Big Bang.

But it is not just galaxies which pervade the universe. We are certain that much of the mass of the universe is made up of totally invisible material, called dark matter, the nature of which is unknown. Although observations in the non-visible parts of the electromagnetic spectrum, such as X-rays and radio waves, reveal previously unknown objects, including pulsars (which are massive but tiny, rapidly rotating stellar remnants), quasars (the high-energy cores of distant galaxies), and black holes (where the density of matter is so great that light itself cannot escape) - despite all these exotic observations, dark matter has not yet been detected. Its quantity, however, is crucial to our understanding of the future of the universe, because if the total mass of the universe is greater than a critical amount the universe will eventually start contracting, but if it is less then it will continue expanding. From present data it is believed that the latter is probably the case.

We do know, however, that our own Sun will have a finite life, that in some 5000 million years it will balloon out into a Red Giant star, and then collapse into a cool White Dwarf star. That will be the end of our solar system and the end of life on Earth - if it hasn't already been extinguished by an asteroid!

Exciting observations in the last few years, however, have provided convincing evidence that many stars in the act of formation show gaseous discs like the one from which our planets, including the Earth, were formed, and there is growing evidence for the existence of planets around other stars. That raises the distinct possibility that there may be life elsewhere in the universe, although there is debate as to whether life could be a common feature of our universe or very rare.

*there is a good possibility that conditions may be such as to favour the development of life elsewhere*

My own feeling is that the billions of galaxies, each containing billions of stars, and our understanding of the development of life on Earth, must argue for life elsewhere in the universe. We are aware that there is nothing special about our Sun; stars like it are common, and if many such stars have planets, then there is a good possibility that conditions on some of them may be such as to favour the development of life.

This raises the question, of course, as to whether the universe was made for the development of life, and, more



specifically, of human life. This is a question which theology is better equipped than science to answer. The Astronomer Royal, Professor Sir Martin Rees, however, has recently published his analysis of six numbers which characterise our universe, such as the number of dimensions and the forces within atoms, and which, if even just slightly different, would have resulted in a universe not favourable to life, or perhaps no universe at all.

For example, are you aware that all the elements heavier than the lightest gas, hydrogen, and that includes virtually every atom in your body, was created in stars: extremely hot stars which exploded as supernovae and scattered their constituents into space, to be gathered together in the nebulous clouds of gas and dust which formed new stars like our Sun, and planets like our Earth. We are, indeed, all made of star-stuff!

*We are, indeed, all made of star-stuff!*

It can, therefore, be said that the universe is finely tuned to create life, or that it is because the six numbers have such specific values that we are here to observe the universe, and that there may be other universes where life is not possible.

In my view, nothing of this is incompatible with the concept of God. Indeed, the more I see of the wonders of the universe the more convinced I am that there must have been a Creator. I find persuasive the arguments of the 18th century theologian William Paley: that if there is a watch then it stands to reason that there is a watchmaker.

Seven centuries further into the past, Saint Anselm expressed the view that he did not seek to understand in order that he might believe, but it was because he already believed that he wished to understand. In that spirit I continue to pursue further experiences and knowledge of the universe's wonders.

And if the Astronomer Royal is right then perhaps God created other universes equally beautiful, complex and incredible as our own, and wouldn't that be exciting!

And we come back to this word incredible, which the Rector put into the title of this talk, along with the words our universe, perhaps recognising that there may be others. Our universe is incredible. It is, indeed, a mystery, a wonderful mystery, full of wonderful objects. We can all see them; all we have to do is to go outside on a dark starry night and look.

And if you want to have a better look please come to La Société's observatory in St Peter's on any Tuesday night. We have new, state-of-the-art telescopes, which enabled me just a few weeks ago, to fulfil a long ambition to glimpse our remotest planet, Pluto. For me, after a lifetime living intimately with the universe there are still such wonders to behold afresh, and I thank you for inviting me to share some of them with you.

***David Le Conte***