Sagittarius

The Newsletter of the Astronomy Section of La Société Guernesiaise

April – June 2013

Forthcoming Events

Spring Star Festival Sark

12th - 14th April 2013

Dr Marek Kukula

Dr Chris Lintott

Steve Owens

Public Open Evening

(now Thursdays)

18th April: 8.30 pm

New format will be that Public Open Evenings will be on a Thursday evening and will comprise a talk or film show, with a clear night for observation being a bonus!

Section meets at the Observatory every Tuesday evening at 8.00 pm

Inside

Inserts

Star chart

Sunset, sunrise, moonset and moonrise times

Possible Life on Mars and on Moons of Outer Planets.

During the second half of the 20th century, space research advanced in many ways, from the launch of the first artificial satellite to orbit the Earth in 1957. The Russian satellite Sputnik-l was followed by a programme of more ambitious spacecraft missions culminating in the first manned orbital flight in 1961.

Further developments by Russia, and increasingly by the USA, produced manned space stations and the Apollo series of missions to the Moon. With wider international participation in more recent years, it became practical for unmanned and more complex spacecraft to be sent out on deeper missions into space, to investigate what conditions may be like on other planets and moons in our solar system.

From the time when telescopes were invented at the beginning of the 17th century, astronomers looking at Mars, with its polar caps and some detail of surface markings, have wondered if life of some kind could exist there.

Of the two nearest planets, Venus and Mars, the planet Venus was found to have very hostile conditions, with a very high temperature and atmospheric pressure, caused by its closer orbital position around the Sun. The extreme conditions on Venus were confirmed as a result of the first landing on the planet, by a Russian spacecraft in 1970.

In contrast, on the other side of Earth's own orbit, Mars is the most Earth-like planet in several ways. Although Mars is much smaller and further away from the Sun, it is considered to be within the region of the Sun's 'habitable zone', where life of some kind could have evolved. Mars has no lasting water on its surface, because of the very low atmospheric pressure at present, and surprisingly it is calculated that Mars has about the same total land area as that of our own planet. The length of a day on Mars is about the same, and the axis of rotation is also similar at present, producing seasonal variations during its rather longer orbit around the Sun.

The presence of water is regarded as being essential for the existence of life anywhere, and Mars has a plentiful supply of water ice and carbon dioxide held in its polar caps. The northern ice cap of Mars is by far the most substantial of the two, and in conditions of melting would be sufficient to cover the surface with water to a depth of many feet. A study of the Martian surface by telescope and orbiting spacecraft has shown evidence of water flows on the surface. This can only happen if there is adequate atmospheric pressure, so conditions must have been different during an earlier period of Mars history.

The astronomer Carl Sagan expressed the strong belief that life must once have existed on Mars, and the search for evidence of past life on Mars, perhaps continuing as living

organisms of some kind, has been started, with spacecraft missions and the landing of robotic vehicles on the planet.

In 1976 two VIKING mission spacecraft landed on Mars, with the aim of testing soil samples for the presence of life. In these experiments nutrients were added to the soil and heated, with the expectation that any microbes or organisms there would react, with the release of carbon dioxide, or methane. Some of the results were very surprising and positive, but the reasons for such a positive response were uncertain. It was thought that a chemical reaction of some kind could be an alternative explanation instead of the presence of life. Some of the experimentation had failed to identify any organic molecules in the soil. However, Dr Gilbert Levin, one of the principal specialists of the mission, had conducted a key experiment in the search for life and was sure that the presence of living organisms had been confirmed.

Because of the uncertainty, the official NASA announcement as a result of the mission was that there was no evidence of life on Mars, and that experiments were continuing in attempts to find an alternative explanation for the results which had been obtained.

In 1980, Dr Robert Jastrow, founder and director of the Goddard Institute for Space Studies, announced that following investigation of data from the Viking mission soil tests, an unmistakable signal for life had been identified.

No alternative explanation for the Viking results seems to have been found, and quite recently it has been acknowledged more openly the results were inconclusive. It has also been pointed out that the complexity of the results were to be expected in comparison with inert samples containing no life of any kind, and that this complexity was exactly what the scientists had found.

In recent years there has also been the detection of substantial areas of methane on Mars. Although this could have a biological origin, it is thought that this could also be caused by volcanic activity, but there is no evidence of such activity on the surface at present. A marked decrease in the amount of methane has also been found following its discovery, so it is thought unlikely that it is being replenished on a continuing basis.

Apart from Mars, there are several other candidates for the possible existence of life in our solar system. Proximity to the Sun and its warming effect is an obvious factor for the potential development of life, but there can be other causes of heating. The huge gravitational attraction of the giant planet Jupiter is known to have produced the extensive volcanic activity observed on its close moon Io. The extent of the activity was a major surprise when the VOYAGER mission passed Jupiter and near Io in 1979, before continuing a tour of the outer planets. Jupiter's moon Io was

confirmed as being the most volcanically active moon in the solar system.

Jupiter's more distant moon Europa was also found to be showing the effects of gravitational attraction. Europa's greater distance from Jupiter has preserved an icy surface, but this was observed to be cracked extensively, and with evidence of movement like large ice floes. It has been concluded from the observations that there must be an ocean below the ice, and with the water being warmed by the tidal effects of Jupiter's gravity. In this case the conditions in a warm ocean could be very suitable for the evolution of life, but any space mission to land on Europa and to drill through its thick icy crust, with the purpose of investigating the ocean below would be a very major project.

The more recent CASSINI spacecraft mission to Saturn and its moons has also produced surprising results, with a flyby of its moon Enceladus identifying many fountains of watery jets and ice particles coming from what must be a sub-surface sea. The spacecraft has passed through the vapour from this several times, and has found from analysis the same level of salinity as that found in our own planet's oceans. The leader of the Cassini Imaging Science team has suggested that with a sub-surface sea, organics and an evident energy source, there could be the same type of life as that found in similar environments on Earth.

The other major and perhaps the best candidate for life on one of the moons is Saturn's largest moon Titan. There have been significant surprises, because this moon was not expected to have a very substantial atmosphere. As it turned out, when Titan's atmosphere was sampled and analysed, it was found to be several times more dense than our own atmosphere.

The Cassini mission also carried the European Space Agency's HUYGENS space probe, which separated from the main spacecraft and landed successfully on the surface of Titan. During its descent many images of the surface were obtained, with these showing lakes and rivers found to contain methane. As a result, it is thought that Titan could have some of the same conditions which existed on Earth during its early history, and that the evolution of life there is a distinct possibility.

On our own planet, we are quite familiar with many of the life forms which share the world with us, both animate and plant life, existing in its different lands and oceans - from the warmer equatorial areas to the coldest parts of the continents and polar regions. With recent and continuing discoveries, it now seems that life of some kind is able to exist everywhere on the planet, and in the most extreme conditions, in deep caves away from any daylight, close to the heat of volcanic activity, and even near volcanic vents on the ocean floor where small creatures have been found in quite poisonous surroundings, and in conditions of great pressure caused

by the depth of water. Such living creatures have been given the name extremophiles because of these conditions in which they have become able to live.

For the most recent development in the search for life, we should look back again at the planet Mars. On August 6th, 2012, the most complex landing of the heaviest and most advanced robot vehicle was achieved successfully, and with great accuracy at the site of Gale crater, a location where observational evidence had already suggested the likely presence of water in the past. The vehicle, named Curiosity, soon gathered soil samples from its immediate surroundings, before beginning further exploration of the area. Almost 40 years after the original Viking mission and soil tests, there is a preliminary report that the latest finding has already identified organic compounds in the Martian soil. If confirmed, the presence of organics may finally indicate that some kind of life elsewhere, if only in its basic forms, is an actual reality, and that life has evolved on more than one planet in our solar system.

Geoff Falla

Astronomical Pub Signs

I was in Melton Mowbray recently, and noticed a sign for a pub called *The Half Moon*, perhaps inevitably depicting a crescent moon. By coincidence I then came across a pub called *The Eclipse Inn* in Winchester, its sign depicting the moon as considerable smaller than the sun. A brief trawl on the Internet threw up another *Half Moon* pub in High Wycombe with a sign again showing a crescent moon. I understand that this sign was replaced several years ago, but I have not found an image of the new sign.

Figure 1 Half Moon, Melton Mowbray.

No doubt the designers would claim artistic licence in their (mis-) interpretations of astronomical events. However, there must be other astronomically-named pubs, and perhaps it would be too much to hope that some are accurate depictions.

Figure 2 The Eclipse Inn, Winchester

Several years ago Ken Staples organised a highly successful Astronomy Section treasure hunt, based on places in Guernsey with astronomical connotations (such as *The Plough* in Vauvert and *The Half Moon* restaurant). I wonder whether any members know of signs with an astronomical theme, either in the Channel Islands or the UK.

Figure 3 Half Moon, High Wycombe

David Le Conte

Reflections on Reflection

Light reflects and refracts and can be mapped out in rays, it travels as particles although it is surely a wave. These facts have been known as contrary ideas since the time of Newton who invented classical physics, and the reflecting telescope. Since those times, as many questions have been discovered as answers and as many wrong answers as right ones. There are some things we can say about reflection with confidence, most of which were described by Newton himself.

The angle of reflection from a polished flat surface is equal to the angle of approach of the beam of light and a plane at right angles to the surface. The colours reflected are the colours incident minus any which are absorbed or transmitted through the

material, reflection does not change the wavelength of light. All materials become transparent if they are made thin enough, even gold which transmits blue light. And, reflection from a flat surface increases with the angle of incidence so that reflection becomes complete as the incident ray approaches a path parallel to the surface. *"In this Proposition I content my self to have put it past dispute, that Bodies have such Properties…"* Newton 'Opticks' 1675.

Almost two hundred years later Leon Foucault developed polishing techniques which could turn the hemispherical mirror of Newton's reflecting telescope into a parabolic one, a design which can then be enlarged without increasing distortion. This was the premier development in astronomy at the time. Mirrors could be ground from any stable glass blank and then silvered, whereas refracting lenses had to be made of two layers of glass of differing refractive index so that their distortions would counteract each other. These operations were complex, expensive and often unsuccessful so when Foucault perfected the parabolic mirror it enabled far superior telescopes to be built. These new telescopes had much shorter focal length making them far more manageable as well as reducing the size and cost of observatories.

At about the same time, James Clerk Maxwell was preparing his wonderful formulae for publication. Light could now be understood as electric and magnetic vibrations travelling together but at right angles to each-other. The speed of light could be calculated as well as measured and the polarisation of light could be understood as the alignment of the electric and magnetic planes. The great revelations of modern physics followed, first relativity, then quantum mechanics and then the discovery of the size of the universe. The photon, and its dual particle-wave nature, was accepted as a necessary concession to the requirements of logic and the freedom of opinion. An exact description for the process of reflection was almost overlooked in the rush to develop applications for these amazing new ideas.

What then have we learned about reflection over the last century? It seems that individual photons are absorbed by individual atoms, raising one of the atom's electrons into a higher energy orbit. That energy is then retained by that atom for a short, but not specific, duration. The likelihood of enough photons being delayed by our bathroom mirror for us to become aware of any delay in the reflection is infinitely small but such considerations are relevant to the design of lasers where the emission of photons is stimulated by reflection. We can bounce lasers from the Moon using corner reflectors, three flat mirrors all at ninety degrees to each-other will reflect light back the way it came. Optical fibre where rays of light are maintained at a low angle to the inside surface of a glass filament employ multiple reflections, almost without loss, to allow complex and densely packed signals to be

transmitted efficiently over large distances.

We have also learned much about the reflection of wavelengths outside the visible range such as the reflection of any radiation by any conductive mesh so long as the holes in the mesh are smaller than its wavelength. This enables us to build large radio telescopes and radar systems. We can reflect radio waves from meteor trails and from the conductive ion layers which follow the magnetic field lines outside the atmosphere. We can reflect radar from satellites off the surface of other planets for contour mapping and to find sub surface water.

Nevertheless, there are questions raised by Newton which remain a mystery. Not least of which is the comparison between reflection from a polished metal surface and the reflection from a transparent layer. The polished metal surface is reflective irrespective of what is behind it but a layer of transparent material will reflect light only when its thickness is some multiple of the wavelength of the light in that material. These appear to be two completely different mechanisms for reflection, the first a reflection involving absorption and emission, the second just a constructive interference. As with all particle interactions, macroscopic analogies are poorly matched to the infinitesimal world.

There are important lessons for us here. Our human perspective leads us to certainty where logic seems complete but faith in physical interpretations is often premature. We reflect each others ideas in communication, when we write and when we teach. In this way ideas are amplified, they are given status but not validity. Whatever we learn we must pass through our own filters for truth. As we progress those filters are modified as much as the ideas and we learn both, the limits to knowledge and the endless scope of investigation.

John Newell

[John is a former Astronomy Section member, now living in South Australia. This article was originally published in the monthly newsletter of the Astronomical Society of South Australia, "The Bulletin" in August 2012]

Geoff Falla's regular roundup of articles from popular Astronomy and Space Journals

Goodbye to the Legendary Sir Patrick Moore. The memorable astronomer Sir Patrick Moore passed away on December 9th, 2012, at the age of 89. His knowledge of astronomy, contained in his great many books and other writings, and in the longest running TV series "The Sky at Night" are recalled by his colleagues, friends, and others introduced to astronomy by this remarkable man. (Astronomy Now, January 2013)

Dark Energy and the Future Universe. The unknown nature of Dark Energy which is found to make up most of the Universe has been found to be accelerating its expansion in a dramatic way. This expansion is expected to gradually remove stars and galaxies to more distant locations, and as part of a continued process in the separation of matter. (Astronomy Now, January 2013)

Herschel Revisited. The famous British astronomer Sir William Herschel was chosen as a subject of BBC TV's Stargazing Live series in January. A selected project for 2013 is to be a reconstruction of Herschel's twenty foot telescope, and to make this available to the public on a site at Derby University, Derby being a city where the first Astronomer Royal, John Flamsteed, came from. (Astronomy Now, January 2013)

Closing in on Dark Matter. After many years of experiments, including use of the Large Hadron Collider particle accelerator, scientists are coming closer to understanding the mystery of dark matter, from evidence of its apparent gravitational effects on the movement and rotation of galaxies. (Sky and Telescope, January, 2013)

Mars Rover Curiosity begins Exploration. Following its successful landing at Gale Crater in August 2012, the Mars Rover Curiosity is beginning its two year exploration and suitability for past life on the planet. Article contains details of the preparatory stages after the landing and the proposed route of the vehicle. (Sky and Telescope, January 2013)

The Top Ten Space Stories of 2012. A summary of the most significant discoveries and developments of the year, including the discovery of the Higgs boson particle which is involved in giving atomic particles their mass; the finding that a type 1a supernova can form and explode in two different ways; and a privately developed spacecraft, the Space X Dragon capsule which completed its first docking with the International Space Station. (Astronomy, January 2013)

How Voyager changed the Solar System. A summary of how the launch of two spacecraft in 1977 on a planned five year mission to Jupiter and Saturn developed into a tour of all four of the major outer planets, with many surprising discoveries and with communication still continuing after more than 35 years. (Astronomy, January 2013)

When Stars go Bang. Stars exploding as supernovas reveal the last stages of these stars, leaving behind extreme objects in the form of neutron stars and black holes, and with some of the supernovas being linked with gamma ray bursts, the most powerful explosions. Some types of supernova, the more extreme examples, explode in unusual environments, and are more difficult to understand. (Astronomy, February 2013)

Volcanoes of the Solar System.

Apart from the volcanoes on our own planet, there are many volcanoes elsewhere in our solar system, some of these of extraordinary size and in surprising locations. The largest has been found on Mars, and several moons - including Jupiter's small moon Io, also show ample evidence of volcanic activity, for different reasons. (Astronomy, February 2013)

Cosmic Dangers. A set of articles on possible dangers from space, including the unpredictable chance of radiation from a supernova, the probability that the solar system will meet a thick band of dust in space, or the effects of known wavering above or below the plane of our Milky Way galaxy. Also the risks from uncharted asteroid impacts, and what may cause the eventual end for life on Earth. (Astronomy Now, February 2013)

The Southern Hemisphere Solar Eclipse, 2012. The only total eclipse of the Sun in 2012 was given only an even chance of being seen because of cloud, but as it turned out at Palm Cove in Queensland, Australia, there was a gap in the clouds just in time for the November eclipse. A large group of British observers led by Dr John Mason obtained excellent views of the eclipse, and with one of the best photographs, showing the diamond ring appearance, obtained by Alderney resident astronomer Michael Maunder. (Astronomy Now, February 2013)

Planets in Chaos. It customary to think of planets orbiting around the Sun in precise unvarying movement, but chaos theory suggests that slight variations in the past may have led to more unstable results in the system. (Astronomy Now, February 2013)

Secrets of the Northern Lights. The appearance of the Northern Lights was a complete mystery during the earlier history of astronomy. Many of the aurora's secrets, including the link with solar production of electrically charged particles, were confirmed at the end of the 19th century by the Norwegian scientist Kristian Birkland, (as outlined in Sagittarius issue January-March 2012) and there have been continued studies to understand this often spectacular phenomenon. (Sky and Telescope, February 2013)

The Great Meteor Procession of 1913. There can sometimes be a very special meteor display caused by a large meteor breaking up in the atmosphere. The most remarkable of all displays happened a hundred years ago, in February 1913, when a long procession of meteors was seen along a track crossing Canada and the Atlantic Ocean. (Sky and Telescope, February 2013)

New Observatory for study of Cosmic Rays. The world's largest cosmic ray facility has been built near Malargue in the western part of Argentina. The detectors of the facility will help to explain some of the remaining mystery of cosmic rays, in particular Ultra High Energy rays, which have particles far more energetic than those produced by Europe's accelerator, the Large Hadron Collider. (Astronomy, March 2013)

How astronomers know the Age of the Universe. There are ways of dating the age of materials, such as from the amount of radioactive decay. In the case of the age of the universe, this has been determined accurately from analysis of patterns produced by sound in the cosmic microwave background, a result of the "Big Bang" at the beginning of the Universe. (Astronomy, March 2013)

Some Astronomical Mnemonics

Nine planets (including Pluto, classified as a planet from its discovery in 1930 until its re-classification as a dwarf planet in 2006)

[Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto]

***M**y **V**ery **E**nergetic **M**other **J**ust **S**erved **U**s **N**ine **P**izzas.*

***M**en **V**ery **E**asily **M**ake **J**ugs – **S**erve **U**seful, **N**ecessary **P**urposes.*

Eight planets (following Pluto's reclassification as a dwarf planet in 2006)

[Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune]

***M**y **V**iolent **E**vil **M**onster **J**ust **S**cared **U**s **N**uts.*

***M**y **V**ery **E**ducated **M**other **J**ust **S**erved **U**s **N**achos.*

***M**y **V**ery **E**asy **M**ethod: **J**ust **S**tay **U**p **N**ights.*

Zodiac signs

[Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, Pisces]

The Ram, the Bull, the Heavenly Twins,
And next the Crab, the Lion shines,
The Virgin and the Scales.
The Scorpion, Archer, and the Goat,
The Man who holds the Watering Pot,
And Fish with glittering scales.

***A** **T**ense **G**rey **C**at **L**ay **V**ery **L**ow, **S**neaking **S**lowly, **C**ontemplating **A** **P**ounce.*

Colours of the rainbow (the visible spectrum)

[Red, Orange, Yellow, Green, Blue, Indigo, Violet]

ROYGBIV

Roy G Biv

***R**ichard **O**f **Y**ork **G**ave **B**attle **I**n **V**ain.*

Spectral classification of stars

[O B A F G K M]

***O**h **B**e **A** **F**ine **G**irl – **K**iss **M**e.*

David Le Conte

Spring Star Festival in Sark

To celebrate Sark's 2nd anniversary of their Dark Sky Island/Community status, a spring Star Festival is being held over the weekend 12th - 14th April organised by Sark Astronomy Society (SAstroS).

The Spring Star Festival will start on Friday 12th April with a fish and chip supper at the Island Hall in the company of guest speakers, Dr Marek Kukula (Public Astronomer, Greenwich Royal Observatory) returning for a 3rd visit, and Dr Chris Lintott (presenter, Sky at Night.) A short film will be shown after this and, weather permitting, some stargazing.

A hosted dinner at Stocks Cider Press Room will take place on the Saturday evening, 13th April – please contact Stocks on 01481 832001 to book.

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