

Sagittarius

The Newsletter of the Astronomy Section of La Société Guernesiaise
July – September 2006

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

Exploring Mars

Matt Golombek is a Planetary geologist working at NASA. He was the co-chairman of the Martian Rovers landing site selection committee. When asked if life had ever existed on Mars, he replied "That is a hard question, because we don't even know how it happened on Earth".

Mars has always had a fascination for us, ever since Christian Huygens in 1659 observed a large dark triangular patch, which we now call Syrtis Major and G.D. Cassini who in 1666 observed the polar caps. William Herschel, between 1777 and 1783 discovered that the inclination and rotation period of Mars is very close to that of the Earth. It is no wonder then that this was a place which had to be explored.

Until the mid sixties, it was reasonable to expect that the Syrtis Major could be a dried up ocean with primitive organic matter. So in 1965 when the first probe was sent on its way, it caught everyone's imagination.

Marina 4 passed by Mars taking pictures from a distance of eight thousand miles. Disappointment summed up these pictures. Syrtis Major turned out to be just a lofty plateau, craters seemed to be everywhere and Mars resembled the Moon, rather than a fertile world. In 1969, a few days after Neil Armstrong and Edwin Aldrin landed on the Moon, Mariners 6 and 7 also flew past

Mars. These vehicles sent back similar pictures to Mariner 4.

The story begins though in 1971. It turned out that by sheer bad luck, Mariners 4, 6 and 7, which after all had only flown past, had seen only the uninteresting areas of Mars. Mariner 9, on the other hand was placed in orbit in 1971 and sent back remarkable pictures of deep valleys and towering volcanoes. But most remarkable of all, what looked like dried up riverbeds. These riverbeds suddenly jolted everyones attention. The idea of finding oceans was long gone. But now, if these are old riverbeds, then we were looking at a world which at some time in the past did have enormous amounts of water and which raised the possibility of life.

So between 1969 and 1971, Mars went from a high expectancy to a low interest, then back to a high interest, with these possible old river beds.

In 1976 NASA sent their two Viking crafts. Each orbited the planet and each had a lander which when released, landed on opposite sides of the planet with Viking 1 at 23° North and Viking 2 at 48° North. Each lander was programmed to scoop up soil and test for signs of life. Although the first test proved positive, all subsequent tests proved negative and so it was deemed inconclusive.

Meanwhile, the orbiting Vikings made a significant find, in that both polar caps are in fact made of very thick water ice, with only a surface of solid carbon dioxide. The Vikings also found that because like the Earth, it is furthest from the Sun in southern winter, that the southern cap contains more water ice and more carbon dioxide as it condenses from the atmosphere in the extra cold winters. It was also found that the carbon dioxide evaporates back to the atmosphere in the summer.

The Viking orbiters also discovered more information on the dust storms. The weather pattern on Mars is simpler than the Earth, because there are no oceans. When the south is in winter, there is a big difference in temperature between the poles and there is an atmospheric flow from the north pole to the south. As the season changes so does the direction of flow. At the same time, as the planet rotates, the thin atmosphere allows the temperature of each surface area to change very quickly. As night falls, this produces a flow of atmosphere around the planet. This combination of winds causes eddy currents which raise dust from the surface. These are usually local, but a lot of dust absorbs radiation from the Sun, creating further differences in temperatures, so increasing the wind speed and the size of the storm.

The Viking missions were a great success. The information obtained made it clear now where further study was needed. NASA resolved to explore four main areas of research:

- (1) **Life**, which first meant look for water.
- (2) **Climate**, a study of the polar caps and the atmosphere.
- (3) **Geology**, a study of volcanism, age and materials trapped in the rocks.
- (4) **Prepare for Humans**. A study of the radiation. Chemical composition of the soil and landing techniques.

Between 1996 and 2001, there were five probes. The Global Surveyor was launched in November 1996 and put into Mars orbit. It mapped virtually all of Mars and at the same time studied the magnetic field and gravity anomalies. In fact Global Surveyor is still in orbit now (2006) and working well. Also in 1996 the Pathfinder Rover vehicle was launched and successfully moved over an area in the Ares Vallis region, now known as the Sagan Memorial Station. The Rover sent back details of the nearby rocks, but only lasted for three months.

There were two failures, Mars Orbiter in 1998 was intended to study the atmosphere, but signals were lost as it approached orbit. Polar Lander was to land at the edge of the south polar cap, but communications were lost on the final approach.

Mars Odyssey was launched in 2001. It achieved orbit in March 2002 and is still working well. During this time it has been recognizing different minerals on the surface and measuring radiation. The data is expected to assist understanding of climate and potential radiation hazard to humans.

From 2002 onwards, we had Orbiter and Odyssey orbiting Mars. Then in December 2003 NASA's land vehicle "Spirit" came out of its air bags, once they had stopped bouncing. That made three vehicles now at Mars. Two in orbit and one on the ground. Three weeks later, Opportunity also arrived in air bags. That made four. While Spirit and Opportunity were getting their motors started, The European Space Agency's Mars Express arrived in orbit, making five. There was supposed to be a sixth, but the lander, Beagle 2, when released by Mars Express, failed to communicate.

So that is the situation today, (June 2006). Three orbiting crafts and two surface vehicles. Orbiter is working independently with NASA. Spirit and Opportunity are controlled and send pictures directly to the Jet Propulsion Laboratory, although sometimes it is more efficient to use Odyssey as a relay station. Mars Express has support teams at Noordwijk, Netherlands and Darmstadt, Germany and can also communicate with Odyssey, Opportunity and Spirit.

So, what has been discovered so far?

Well, Mars is an interesting planet. It is about half the size of the Earth. The equator roughly divides two different hemispheres. The southern is on average about two miles higher than the north and has more craters, making it older. The younger north has more areas covered in volcanic lava. In fact the largest volcanoes are in the north. Mars has a very weak

magnetic field which indicates an iron rich core. The surface is covered in rocks, which are due to impact and volcanism. The atmosphere is 95% carbon dioxide and the sky is pink due to the pink dust. But the big questions of water and life have still to be resolved. It has been proved that water ice exists in large quantities at the poles. Both Opportunity and Spirit have found rocks which give every indication of being formed in water. It has long been felt that if there is liquid water, it would be in equatorial regions, underground. As Michael Carr wrote in New Scientist "You can trace the river valleys carved by water down to an area near the equator".

Mars Express is a very sophisticated probe. It has instruments ranging from those that measure molecules per cubic metre in the atmosphere, to a radar boom known as MARSIS (Mars Advanced Radar Subsurface Ionosphere Sounding). MARSIS has now been deployed and is looking for underground water or ice. European scientists, controlling Mars Express, have indicated that initial findings appear to confirm an area near the equator measuring 500 miles by 400 miles of underwater ice. They are quick to stress though that any surface water would immediately turn to water vapour.

Mars Express has confirmed that the poles are water ice and it has also photographed a very impressive crater near the north pole about twenty three miles in diameter, but with an eight mile diameter lake of ice. It is unfortunate that the landing craft

Beagle 2 did not respond, as the orbiting Mars Express could have guided it to interesting areas, but Mars Express itself is working well.

It is anticipated that along with NASA's ground based and space

vehicles, and with future planned missions, we will hear and see quite a lot more of Mars.

Frank Dowding

Solar Corona Heating Explained.

A total eclipse of the Sun, as recently observed from the most favoured areas of North Africa and Turkey, gave astronomers a rare opportunity of studying the solar corona. This is usually lost in the Sun's glare, but becomes visible when the Sun is totally obscured, as at the time of eclipses.

Although the Sun is very close to us in comparison with other stars, there are still some aspects of its energy and radiation mechanisms which are not yet fully understood. One of these puzzles is why the solar corona, the outer atmosphere of the Sun, has in fact been found to have such a very high temperature in comparison with the photosphere - the Sun's visible surface. The corona, as observed during eclipses, also varies in size and shape, depending on the amount of activity on the Sun, varying over the average 11 year cycle from minimum to maximum sunspot activity.

The temperature of the Sun must decrease from its core to the surface, where it is measured to be at a temperature of about 6,000 degrees Centigrade. The solar corona,

however, a tenuous gas reaching out to a distance of more than the Sun's radius, has been found to have a far higher temperature. The corona is measured as being at more than a million degrees Centigrade, and with no real understanding of why this should be so.

We are told that the Sun's composition is almost entirely hydrogen and helium, and that the Sun's energy comes from nuclear fusion with a steady conversion of the Sun's hydrogen content into helium. Radiation from this process, in the form of ultraviolet and X rays, reaches Earth in about nine minutes with much of this radiation being absorbed by our atmosphere.

There are also more violent solar events. The Sun contains powerful magnetic forces, and currents within it rise to the surface, producing the sunspots with their own strong magnetic fields and other features. If the magnetic field in these areas becomes disrupted by surface pressures, this can produce an eruption in the form of a solar flare, and coronal mass ejections of charged

particles. These normally take two days to reach Earth, interacting with our planet's own magnetic field to produce the glowing polar aurora effect, and sometimes also causing severe disruption to communications.

It is claimed that charged particles emitted from the Sun in these violent events are actually accelerated as they travel outwards past the Earth and into deeper space. It is known that there is plasma - hot electrically charged gas, making up part of the Sun's outer layers as well as being contained in the outward streams of charged particles. Magnetism is very evident in solar processes, but although electricity and magnetism are closely linked the presence of electricity in relation to the Sun seems to be rarely mentioned.

The heating of the solar corona is evidently not explained satisfactorily by the Sun's nuclear fusion process, or by other factors. Some recent research

has suggested the possibility that the unexplained coronal heating could be produced by electricity, in the form of a plasma glow discharge. In this case the Sun's corona could, as it happens, be aptly named since a corona is also produced by an electrical discharge effect. It is thought that plasma, electrically charged gas together with electric currents could be far more important in solar and planetary interactions than has so far been acknowledged.

Geoff Falla

References:

Our Electric Sun, NEXUS Vol 12, No 5. August-September 2005. (NEXUS Magazine specialises in the publication of new research in a variety of subjects.)

The Science behind the Solar Corona, Sky and Telescope, April 2006.

Ministry of Defence accepts UFO Phenomena.

If while observing the sky any of us happens to see some unexplained object, which may perhaps be described as a UFO, we can now rest assured that this may not be just a misinterpretation of some common object, or that it may be a case of having a vivid imagination – explanations sometimes put forward by those who are only too keen to brush aside all such reports, regardless of the evidence.

It was revealed recently in broadcast news headlines, followed up by reports in national newspapers, that the Ministry of Defence has completed a four year study on the subject of UFOs, and resulting in a 400 page report. The study, carried out in secret during the years 1996 - 2000 by its Defence Intelligence Staff, and unknown even to the Minister of Defence at that time, has concluded

that reported sightings of glowing objects moving around in the sky are real, and that these sightings are probably caused by a plasma phenomenon produced by electricity in the atmosphere. It is not yet fully understood by scientists how such a plasma could be produced, but this seems to be the most justified explanation for what has been reported.

The release of the Ministry report came about as a result of the recently introduced Freedom of Information Act, and a request by Dr David Clarke of Sheffield University, and amateur astronomer Gary Anthony. The information in the report confirmed that all British UFO reports have been logged by a special unit of the Ministry, and in many cases investigated over a period of thirty years, at an average of about a hundred cases per year up to the time that the report was completed.

Many UFO reports are, however, much more than glowing objects in the sky, but the Ministry does not accept that any of the reports have evidence of alien visitations. This probability however has already been accepted by past official investigations in the United States, and in France by a National Defence study as recently as 1999.

The Ministry conclusion that some of the reports may be explained by a plasma phenomenon does seem to be a definite step forward. It seems that it may have also acknowledged the existence of reported electromagnetic effects, which have become a well established and difficult to explain feature in many of the reported events. Hopefully this may encourage more scientists to take an interest in the subject.

Geoff Falla

Tides and Eclipses

In his excellent book "Gravity from the Ground Up" Bernard Schutz points out an interesting connection between tides and eclipses. The strength of the tidal force of a body such as the Sun or Moon depends upon the mass of the body and its distance from the Earth. The overall gravitational force falls off as the inverse of the square of the distance. The tidal force, which is the difference between the gravitational force at the centre of the Earth and the

surface, falls off much faster, as the cube of the inverse of the distance. With a little mathematical manipulation this is the same as saying that the tidal force is proportional to the density of the object times the cube of its apparent size (measured by its angular diameter) in the sky. Now the Sun and the Moon are the objects with by far the largest apparent size in our sky, so the calculations lead you to expect that

they will be the only bodies with significant tidal effects. They also happen to have almost exactly the same apparent size, as evidenced by the ability of the Moon to just eclipse the Sun. This implies that any difference between the tidal effects of the Moon and the Sun is entirely due to the difference in their densities. The

Moon, made of rocks, is about 2.4 times as dense as the Sun, made of gas, and so the tidal effect of the Moon on the Earth is about 2.4 times that of the Sun.

Peter Langford

Suspended Animation – Science Fiction?

Do you every fall asleep on a long car journey? Certainly not at the wheel and most likely never in Guernsey even as a passenger. But for a mission to Mars it might be a necessary requirement for the voyage. George Bush has announced plans for a mission to Mars as part of the new direction for the US space programme. The European Space Agency too has announced intentions to put a human on Mars by 2033.

ESA has estimated that a two year return mission to Mars would require 30 tonnes of food for six astronauts without considering vital oxygen supplies. If humans could hibernate then less food and oxygen would be needed. But is this the realm of science fiction and such films as 2001? Apparently not as both NASA and ESA have announced research programmes to allow astronauts to sleep for long periods in space.

How can human hibernation be triggered? Many animals hibernate in winter months using body chemicals which trigger their sleeping state and

also to control metabolism and immune system. One such chemical known as Dadle can put squirrels into hibernation during the summer. Experiments on human cell cultures has shown that cell division is slowed down in the presence of Dadle making Dadle a potential candidate for a hibernation trigger for humans. Further studies have been carried out on non-hibernating animals such as rats.

Mice can be put in a state of near suspended animation by hydrogen sulphide gas (remembered as rotten eggs smell from school laboratory days). Test mice stopped moving and appeared to lose consciousness within minutes of being placed in a chamber containing air with hydrogen sulphide at 800 parts per million. Normal breathing rates dropped from 120 breaths per minute to 10 breaths per minute with a 90% reduction in metabolic rate. Core body temperature dropped from 37°C to as low as 11°C. After six hours exposure, the mice were removed from the chamber and allowed to recover. Crucially their

metabolic rates, breathing rates and core body temperatures all returned to normal and tests showed they suffered no ill effects. The mice were effectively being converted from a warm blooded to a cold blooded creature which is essentially what happens when mammals hibernate.

Even if it is possible to induce human hibernation then effects of long periods of inactivity on the human body must be considered. After 3 months of inactivity the human body will lose 90% of muscle strength. ESA is already investigating drugs which could maintain the astronaut's physical health during hibernation. One such drug called dobutamine is widely used to treat bedridden patients to strengthen their heart muscles particularly following a heart attack. However effects of long term use are unclear and in some patients it has been found to have adverse effects on muscle tissue which would be undesirable for an astronaut who is required to remain in peak physical condition. An astronaut's immune system could be maintained using available drugs which are used to treat growth disorders. These are thought to affect every cell in the body and thus the immune system. But these drugs are also not without risk and are thought may potentially trigger the onset of cancer.

Bedsore are another problem associated with long periods without

moving. Bedsore are caused by prolonged pressure on a specific area which causes capillaries to collapse and restricts blood flow to cells. This leads to restricted drainage and flow of nutrients causing cells to die. Electrical stimulation could be used to exercise the astronaut's body in the spacecraft and to cause movement which will shift pressure points. Again, long term effects are not known.

Even if all the physical effects of hibernation could be overcome just how well would the human mind cope with long periods of unconsciousness? Scientists are not in complete agreement but doctors who have worked closely with coma victims think that this may be a minor issue and that the human mind adapts well to the loss of time.

There are clearly many issues associated with how humans will cope physiologically with space travel even to our neighbouring planet. The logistics of such journeys may drive the research into human hibernation but that study looks to be only just starting with a long road ahead.

Colin Spicer

References:

Chemistry World, May 2006

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

Gravity and Planetary Effects. A set of articles focusing on gravity, including the Earth's effect on nearby asteroids, evidence that the outer planets moved into different positions during their formation, and the effects on gravity in forming planetary systems around other stars. (Astronomy Now, April 2006)

Volcanic Ice. The Cassini-Huygens mission has begun studying the surface of Saturn's largest moon, Titan. From what has been found it seems that Titan is a volcanic world, and that the presence of ice volcanoes will soon be confirmed. (Astronomy Now, April 2006)

The Science behind the Solar Corona. The solar corona - the Sun's outer atmosphere which is visible during total eclipses, is far hotter than the Sun's surface. It is known that the corona is shaped by the Sun's magnetic field, but the source of the corona's heating is a long-standing mystery. (Sky and Telescope, April 2006)

A new breed of Black Hole? Astronomers have until now identified only two types of black hole - those which are the remains of massive stars, or much larger ones at the centres of galaxies. It now seems that ultraluminous X-ray sources, first observed in 1999, may be objects of

intermediate mass which are forming accreting black holes. (Sky and Telescope, April 2006)

All about Stars. A set of articles, including facts about the galaxy's biggest, hottest, and most distant stars; massive stars which present problems for astronomers; the nearest stars to us in the galaxy, and the North Star - Polaris, which is still evolving. (Astronomy, April 2006)

The Search for Hidden Dimensions. Scientists are increasingly accepting the idea that hidden dimensions must exist. The first direct evidence may come from the Large Hadron Collider, the most powerful particle collider ever built, when it becomes operational at the CERN installation next year. (Sky at Night, April 2006)

Saturn's Water World - the moon Enceladus. The recent discovery by the Cassini space probe that Enceladus has water vapour over its southern hemisphere, and ice volcanoes, which could mean that signs of life could be found there. (Astronomy Now, May 2006)

Neutron Stars, White Dwarfs and other Oddities. A set of articles focusing on the strange worlds of collapsing stars - white dwarfs, the far smaller neutron stars which are the rapidly spinning 'pulsars' and another oddity which may turn out to be a further development - a quark star. (Astronomy Now, May 2006)

When Black Holes Collide. Although not yet based on observations, theory predicts that in the event of a black hole collision, the merged object would be ejected from a galactic centre by gravitational effects. (Astronomy, May 2006)

Titan reveals Earthlike Surprises. Saturn's largest moon has methane rivers and possible volcanoes. Since the Huygens spaceprobe landing in January 2005, more detailed information about Titan's atmosphere and surface has been obtained. (Astronomy, May 2006)

The Great Telescope Race. New giant telescopes, ground based ones as well as plans for positioning them in space, will greatly increase astronomer's knowledge of the universe. Plans are already being made for launching a new space-based observatory - the James Webb Space Telescope, which will be much larger than the present Hubble Space Telescope. (Astronomy and Space, May 2006)

Cosmic Disasters - Fact and Fiction. Science fiction films sometimes portray disaster scenarios, such as the effects of an asteroid impact on the Earth. How accurate are these, and what are the other real dangers in space? (Sky and Telescope, June 2006)

Venus Express in Orbit. The European Space Agency's Venus Express arrived at the planet in April, and will focus on studying its peculiar atmosphere. It is also planned to

obtain optical views of the surface for the first time, and there are hopes of observing signs of active volcanism. (Astronomy and Space, June 2006)

Evidence of early Mercury Collision. Most of the planet Mercury seems to consist of a large iron core. There is mounting evidence that the planet suffered a massive impact which removed its outer layers, and may have changed its original orbit. (Astronomy Now, June 2006)

Europe's Gateway to the Stars. As with Europe's foothold in major space research projects, it now also has a claim to providing the world's premier observatory. The European Southern Observatory in Chile has four 8.2 metre telescopes, which can combine to form one huge telescope system. (Astronomy Now, June 2006)

Unveiling the Mysteries of Saturn. A summary of what has been discovered since the Cassini space probe arrived at Saturn in 2004, and plans for the second half of its four year mission. (Astronomy Now, July 2006)

The Return of Nemesis. Periodic mass extinctions of species have been confirmed, suggesting that the Sun may have a dwarf companion star in a long period orbit, causing disturbances in the Oort cloud of comets, and sending some of these into the inner regions of the solar system at times of close approach. Minor planet Sedna, recently discovered, has an unexplained orbit suggesting some unknown perturbations. If the Sun

really does have a dwarf companion, it will probably be found in the next five years or so. (Astronomy Now, July 2006)



Section News

This year the July clean up day will be replaced by two clean up evenings (before it gets dark!) on a Tuesday starting at 7 pm on 11th and 18th July. Jobs planned include strimming, revarnishing the door to the Main Building, maintenance to the roof rails, repainting of the run off framework. Additional pairs of hands will be very welcome!

The annual Perseids Meteor Shower Barbeque will be held at the Observatory on Saturday 12th August from 7.30 pm. Unfortunately the gibbous moon will mean that observations will be poor.

We have recently purchased a webcam for use with the telescopes as agreed at the AGM. The webcam has proved to be much more straightforward to use that our CCD camera and it is possible to obtain images quite quickly. However, we need to get fully conversant with the image processing software in order to produce quality images.

Colin Spicer

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