

Speaker:- Melanie Davies FRAS

Subject :- "Titan - A Candidate For Evolution"

Melanie, Director of the Creative Space Science Company, gave a fascinating talk to our society on the subject of Mars last year and we were very pleased to welcome her back for another intriguing talk about Saturn's Largest Moon - "Titan". Melanie has also given informative talks at SAGAS conventions and has her own Mobile Planetarium which is used for Educational and Community Events.

## Brief HISTORY

Christiaan Huygens, a Dutch Physicist and Astronomer who, inspired by Galileo and his discovery of the 4 large moons of Jupiter, decided to build a more advanced telescope. In 1655 he thought he had noticed a Moon travelling around Saturn. Indeed he did -

He discovered Saturn's largest Moon - "TITAN".

Between 1671 -1684 Giovanni Cassini found 4 more moons with the use of an even bigger telescope. John Herschel went on to discover even more moons. Titan was given the Greek Mythological name.

## EXPEDITIONS

Pioneer 11 was the First Probe to visit the Saturnian System in 1979, on the edge of the solar system. Due to modernised instruments, Voyager was able to produce good quality photographs. In 2004 The Cassini - Huygens joint mission landed on the surface of Titan.

## CONDITIONS

Titan has a layered atmosphere of different gases, with an upper layer of thick opaque gas and shallow gas below. This gives Titan a haze effect. At first sight it looked like an orange ball, a bit smaller than Mars. After 13 years of travel and over 100 fly-bys, the Cassini Mission produced a map, consisting of dry river beds, islands, hills, ridges, fluid-borne channels, light and dark terrain.

They had discovered an EARTH -LIKE- WORLD!

It took 2 and a half hours for the lander to descend from Cassini to the surface. At first it bounced a little on a soft soil-like material, also similar to sand and composed of water and hydrocarbon ices. Strong winds were recorded on the microphone which was attached to the lander. It also had a strong light which heated the ground and vapourised the Methane.

Initially it was assumed that the Lander would touch down on a Liquid Ocean and was designed and fully equipped to work accordingly. It came as a source of amazement to find it had landed on an Earth like terrain that had been viewed through a fish-eye lens.

Titan is extremely cold with an icy crust and sub-glacial seas. It has Methane flooded canyons which are active and could be of Volcanic origin; probably a result of geological evolution. While Earth is warm and rocky with rivers of Water, as opposed to Titan which is cold and icy with rivers of Methane, there are still similar features on Both Worlds.

PEBBLES on the ground!...

Water and Ammonia are contained in Pebbles that may have come from the river bed where the lander came to rest. Viewed from the surface of Titan, Saturn would fill 1/3rd of the entire sky. Titan is tidally locked to Saturn and gravity is similar to the moon. The conditions are so cold that it is not possible to breathe the air. Our Sun would look far away, especially when the time comes for it to change into a "Red Giant".

## ATMOSPHERE

There are 15.9 hours to a day, with approximately 8 hours of daylight and 8 hours of darkness. Blue coloured layers at the base of Titan near the South Pole are to be found. At high altitude a Blue Haze is seen in Ultra-violet light. Methane molecules are broken apart by UV. They recombine to form the compound Ethane and Acetylene, which fall as rain.

An Orange Smog is seen in the Nitrogen rich upper haze, with 95% Hydrogen. This blocks the sunlight and creates a Greenhouse effect.

Clouds containing Hydrocarbons evaporate and Rain falls out to the seas and an Organic sludge is created at the bottom of the Oceans. Methane clouds were observed in 2016.

## SEASONAL CHANGES

Saturn takes 30 years to orbit the Sun and has an axial tilt of 26.7 degrees, similar to ours. The rivers and lakes, which contain Liquid Hydrocarbon, swell during the Seasonal changes. Winter is the time when the lakes become larger.

## SEAS AND LAKES

These big lakes are known as Seas and are to be found in the Northern Hemisphere. These contain Ether, Methane and dissolved Nitrogen. In 2014 small waves were detected on Punga Mare in the North Polar region. This was the first liquid rain to be found anywhere apart from Earth. These tiny waves were only ripples of 10mm in height.

Gravitational forces cause the solid material to go to the bottom of the Seas, below the outer ice shell. Water ice and ammonia are under the core. It is an inhospitable environment for us to survive, with 90% of Nitrogenous gases, yet Nitrogen is an essential element for Life.

EXO BIOLOGY...( The study of Life beyond Earth )

A Molecule called " Azotosome " could be a significant find on Titan and is likely to exist due to 2 chemicals that have been researched and are there right now. Hydrothermal investigations were also carried out -

Azotosome is an Oxygen Free Life Form!

## LOOKING TO THE FUTURE

The icy moons surfaces could melt when our Sun turns into a Red Giant and heats the atmosphere. When all the ice has been used up and transformed into Liquid Hydro-Carbon, there is a strong possibility that Life could survive there. Heat energy is also produced. Life could survive in pools created by Meteorite Impacts. Water could combine with the Methane in these canyons and produce a different kind of Life Form!...worlds apart and unfamiliar to us!

NASA and the ESA were working on a project to launch an air balloon to float around Titan and Saturn. This was known as " TSSM " which means 'The Titan and Saturnian System Mission'.. The plan was put on hold because of the exorbitant cost of 2.5 Billion dollars. Instead it was decided to use the money on another idea..a submarine!

## THE TITAN SUBMARINE

The next endeavour is to send a Robotic Submarine into the Kraken Sea, complete with Scientific instruments for research. They want to navigate, find out the depth of the sea, estimated to be quite shallow, and study it closely. This enterprise has been granted funding by Nasa and favoured to become a reality. Planes similar to RAF fighter planes will be used to deliver the sub into The Kraken Mare using Sonar Radar to produce images and information. The sub returns to the surface to transmit the Data. Eventually the data is relayed back to Earth.

A channel system near The North Pole, drains liquid and other compounds into " The Ligeia Mare "- A Huge Hydro-Carbon Sea. Forms of Life could be created from these chemicals. The Scientifically Organic Carbon Chain towards the bottom of the Lakes will be analysed.

Bright areas reveal Water Ice and darker areas Methane compounds. The temperature of Icy Titan is - 180 degrees, with 45% less pressure than the Earth. There is a lack of Wind on Titan, only a breeze, yet the winds can change and during the Summertime it can become a little more windy and produce Waves and Dunes. The higher from the surface the windier it becomes and when lower down near the surface with low wind speeds, it becomes much calmer.

## POWER AND ENERGY

Cassini took 7 years to reach The Saturnian System and was Nuclear Powered. The 'Sling Shot' manoeuvre was used in order to use less fuel and speed things up. With Future Technology we may be able to get there quicker.

With no Solar Power for the Submarine and Plutonium-238 in very short supply, which is the hot, radio-active material Nasa uses to power it's Spacecraft, it has become a problem for Deep-Space Missions of the Future. The " RTG " method will be used as an alternative power source for the Sub. This is called a 'Radioisotope Thermoelectric Generator'.

...Without a doubt, this should prove to be a very exciting Mission.

The intentional 'death dive' by Cassini into Saturn's thick atmosphere in September 2017 was to ensure that the probe did not contaminate Titan and Enceladus ( one of the other Icy Saturn Moons

), with Earth Microbes. Enceladus might also be capable of supporting Life.

## SIMILARITIES

Further similarities between Titan and Earth are Titan's thick atmosphere dominated by Nitrogen, as is Earth - and are also 'The Only Two Worlds in the Solar System that are known to harbour Stable Liquid on their surface'.

...Titan could be the best place to look for Life beyond Earth. ..

- Melanie gave us another enthralling talk. It was very enjoyable and left us with plenty to discuss, during the interval, with positive feedback!