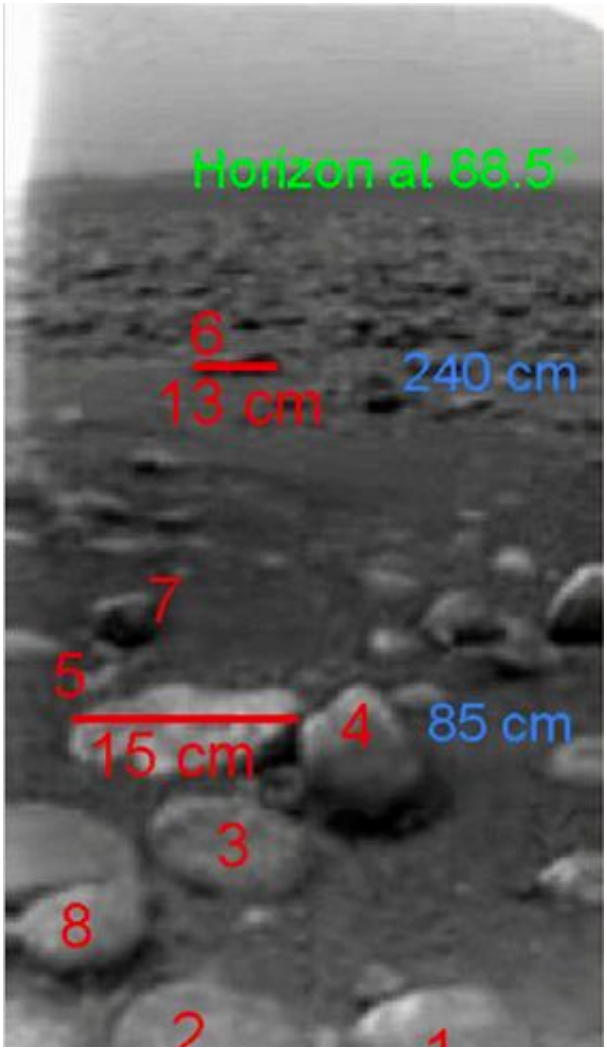
HUYGENS: LANDING IN THE FROZEN WILDERNESS

By Matthias Gründer

For the first time, and watched on tenterhooks by scientists all over the world, a space probe built by human hand peeked below the dense cloud cover of Saturn's moon Titan. The pictures transmitted to Earth show a frozen world.

On 25 December 2004, Huygens separated from its mother probe Cassini and flew towards Titan, over four million kilometres away.



On 14 January 2005, the lander plunged into the atmosphere of the moon at 18,000km/h, causing its ceramic protective shield to heat up to 1800ºC. Within a short time the onboard instruments were exposed to 16 times the acceleration of Earth. At an altitude of around 160km, the main parachute opened, followed at around 120km by a smaller parachute on which the probe floated to the ground. The descent had been planned to last about two-and-a-half hours, during which the lander was expected to meet wind velocities of around 250km/h.

Scientists wanted to determine the direction and strength of this wind through precise measurement of the frequency shift of the signal sent by Huygens to Cassini. The data was transmitted to Cassini at a speed of 8Kbps, saved there and then subsequently transmitted to Earth. Altogether 350 images arrived in this way at the ground station, about one half of the expected output, as one transmission channel of the Huygens transmitter had failed. Nevertheless, this was enough to obtain fundamental scientific data about the nature of the moon, as mission analyst

Michael Kahn confirmed.

The curiosity of the scientific community had been aroused for a number of reasons, in particular, it was hoped that the mission of the European lander, Huygens, would help to answer the question of whether Titan was a kind of second Earth, as it were, a younger brother of our blue planet in its primordial state. For the Saturn moon is the only satellite among all the planets in the solar system to have a dense atmosphere, which suggests that it is similar in structure and composition to the one that enveloped our Earth 3.8 billion years ago.

To establish and maintain an atmosphere, a celestial body must be sufficiently heavy and it must not be too hot, as otherwise the gases would vaporise. The Saturn moon fulfils these conditions. At a diameter of 5,150km, it is bigger than the planet closest to the sun, Mercury, and its surface temperature is only -180ºC.

These extreme temperatures and all the other physical and chemical properties suggest, however, that the moon could not support life forms. On its surface, the atmosphere has a pressure 1.6 times that of Earth's atmosphere and, moreover, it is composed 95% of nitrogen and 5% of methane, also known here as “mine gas”. In the upper layers of the atmosphere a chemical reaction was triggered by sunlight, and this resulted in a dense layer of smog. In short, this entire “soup” is absolutely impenetrable and in the past it has only been possible to make out some lighter and darker areas on the lunar surface by means of infrared observations.

Because methane can be present in all states of aggregation at these low temperatures, up to now opinions have differed widely as to the possible physical properties of Titan's surface. Does the condensed gas form a continuous ocean, does it vaporise into clouds in the atmosphere or, in the form of a sea, does it wash around fixed continents that are eroded by an unremitting rain of corrosive substances? Or could a water ocean be concealed under a closed mantle of ice with a composition that resembles the “primordial soup” on Earth, the cradle of all life? Are complex organic compounds to be found there? And why should Titan have an atmosphere, whereas the equally large and just as cold Jupiter moon Ganymede does not?

Thus, Huygens had plenty of work to do, but not much time available to do it in. In practice, the probe would only have the descent in which to make all its observations with six instruments, as it was assumed that it would either sink into an ocean or crash heavily on a solid surface. Even in the most favourable case of a relatively soft landing, there would not be much opportunity for observation, as the useful life of the onboard battery providing the energy supply was strictly limited.

Altogether, Huygens sent back more data than one could have expected even under the most favourable conditions. In actual fact the transmitter worked for two-and-a-half hours before the onboard energy supply was exhausted. Hundreds of scientists around the world are now working on the analysis, which will last for some months to come. Marty Tomasko of Arizona University, who is responsible for the image processing, called for patience. The first images that one could present to an eager public are by no means fantastic in number and quality, and with the aid of state-of-the-art computer technology it should be possible, he said, to extract a lot more information from the data.

A panorama composed from several black-and-white photographs resembled the aerial image of a coastal landscape, and white spots that were visible on it could be fog patches. Colour interpretations produced a predominantly orange coloured, swamp-like landscape with huge rocks, which looks like a flood plain. Water ice would also be theoretically possible. The sensors of the lander had indicated that the ground at the point of contact was soft, similar to wet sand or clay.

According to ESA specialist scientist Sushil Atreya, the atmosphere appears to be characterised by a dense layer of methane 18 to 20km high, whose origins have still to be explained. There may be a larger reservoir of liquid methane on the moon surface, which evaporates on the surface and then rises into the atmosphere in thick clouds.

Another interesting feature, which the public can retrieve on the Internet, is the wind noises that Huygens transmitted to the earth. However, the most important discovery for the scientists was the discovery of hydrocarbons in the atmosphere, of longer-chain molecules of nitrogen, carbon and hydrogen. These could be interpreted as primitive precursors of amino acids, those building blocks of life which once brought about the beginning of animal and plant life on Earth. But, as stated above, analysis of all the data is still at an early stage. We can only speculate as to the surprises that Titan holds in store for us.

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Last updated 12 February 2005

FLUG REVUE, Ubierstr. 83, 53173 Bonn, Germany