# The Viking Mission to Mars

## AUTOMATIC LABORATORY TO SEARCH FOR EVIDENCE OF LIFE

On July 4th, 1976, an unmanned Viking Lander module is scheduled to make a soft landing on Mars, the first ever on another primary planet. Since its launch from Cape Canaveral on August 20th, 1975, the NASA spacecraft will have travelled about 400 million miles before touchdown on what is regarded by many as the planet most like Earth, and it is this similarity which makes the Vikings' search for extra-terrestrial life such an exciting part of the continuing exploration of space. One of the principle scientific experiments to be conducted by the Viking Lander is the analysis of Martian soil for organic compounds. In this way it is hoped to establish whether the conditions could support life on Mars, whether life at present exists or whether it has existed in the past. This analysis will be undertaken by a small technologically advanced Gas Chromatograph/Mass Spectrometer (G.C.M.S.) delivered to NASA by its prime contractor, Litton Guidance and Control Systems Division, Woodland Hills, California. The G.C.M.S., which occupies about 1 cubic foot and weighs about 44 pounds, contains all the associated electronic equipment for control, programming, data storage and information transmission.

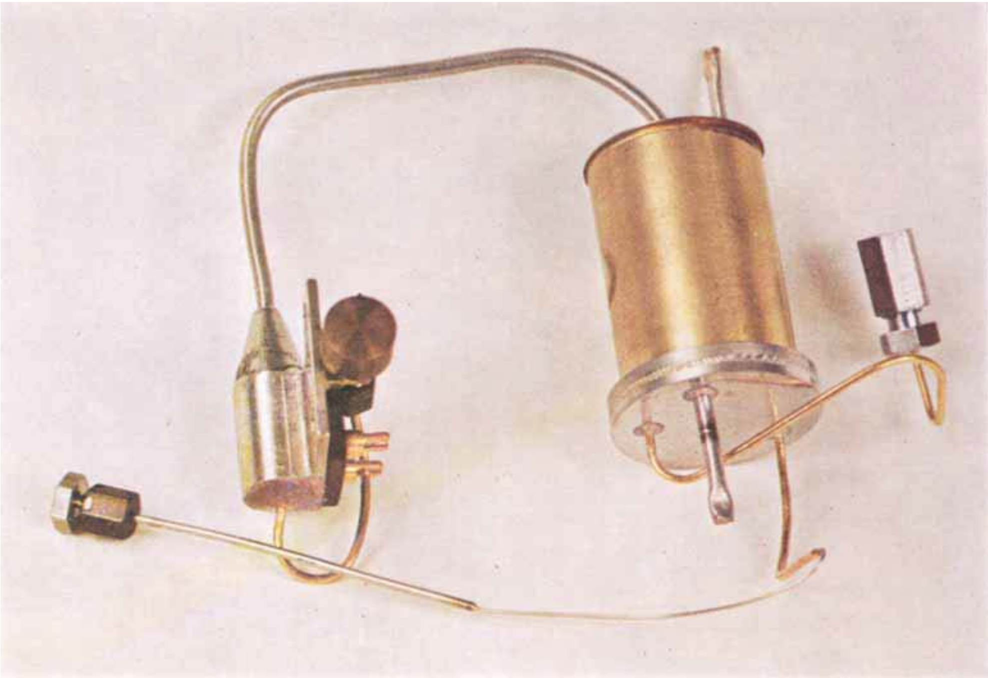
After landing on a pre-selected site a period of time will elapse to enable conditions disturbed by the descent of the Viking Lander to return to normal before sampling commences. Then a telescopic arm will take soil from about four inches below the surface and, after being pulverised to an acceptable mesh size, 100 milligram samples will be loaded into a miniature oven where the contents will be volatilised and ultimately pyrolysed.

Only extremely small quantities of gaseous substances are likely to be released from the soil sample and the G.C.M.S. is capable of detecting nanograms ($10^{-9}$g) of products. These will be carried by a flow of extremely high purity hydrogen from the oven to a gas chromatograph where the components will separate. Before the products pass into a miniature mass spectrometer for identification all the hydrogen carrier gas will have to be removed and this is accomplished by means of an ingenious hydrogen separator designed and built by Litton Industries in collaboration with Beckman Instruments and the California Institute of Technology, Jet Propulsion Laboratory, utilising palladium-silver tubing and gold-platinum-silver alloy supplied by Matthey Bishop Incorporated.

### Palladium-Silver Separator

The "electrolytic pump" which will separate the hydrogen from the soil gas components is just over half an inch in diameter and less than one inch long. It consists basically of two concentric coils of palladium-silver tubing surrounded by molten sodium hydroxide, and contained within a gold-platinum-silver thimble, the largest component in the top illustration, while a gold inlet tube will lead the hydrogen-containing gas from the gas chromatograph to the outer coil. The case base, gold tubes and outer palladium-silver coil constitutes the anode of the device while the inner palladium-silver coil forms the cathode, a voltage of 0.67V being applied between them.

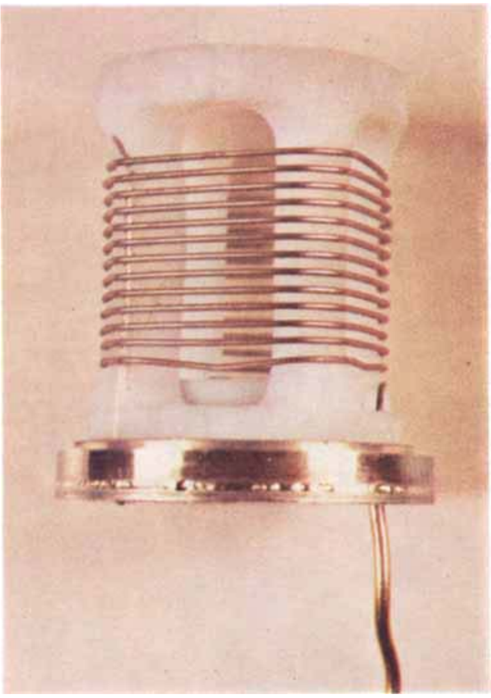
During the short time that the gas is in the coil, seen in the lower illustration, the hydrogen molecules are activated by losing electrons to the wall of the outer palladium-silver tube, becoming positively charged hydrogen ions. In this form, they pass through the solid wall of the tubing and enter the sodium hydroxide electrolyte. There they are attracted to the negatively charged coil where they receive electrons back again—



*The palladium-silver diffusion tubes which form the hydrogen separator are contained in the large cylindrical component. Hydrogen and gaseous products pass from the gas chromatograph along the tube at the bottom of the figure to the separator and from here hydrogen is discharged through the device on the left while the products for analysis are lead through an outlet tube to the mass spectrometer connector on the right*

becoming hydrogen atoms. These diffuse through the wall of the inner palladium-silver coil and then discharge to the atmosphere.

Of course the gaseous components originating from the Martian soil samples will not be able to diffuse through the wall of the palladium-silver tube but, now purified of all the carrier hydrogen, they will flow from the other end of the coil along the gold outlet tube to the mass spectrometer where the analysis will be carried out and any organic substances detected. The results will then be transmitted to Earth and another important step forward in man's understanding of the universe will have been made.



*The outer palladium-silver diffusion coil is about twenty-eight inches long, the internal diameter being 0.003 inch and the external diameter 0.006 inch, and is wound on a Teflon mandrel. The gold inlet tube, seen bottom right, carries the hydrogen and product gases from the gas chromatograph*