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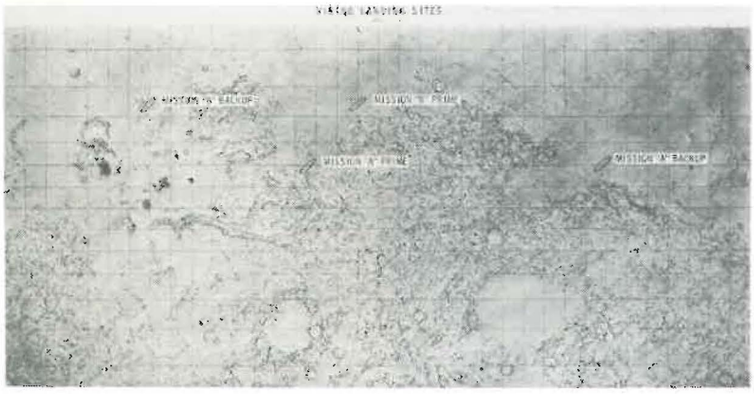
Ames/Viking Atmosphere Experiment



Landing Sites: The regions indicated on this map of Mars have been tentatively selected by NASA as the primary and backup landing sites for the two Viking spacecraft. They will journey for almost a year through space before arriving at Mars.

In previous issues, the Astrogram has reported on the important role of Ames investigators in the Viking Life Detection Experiment. It is less widely known that this Center has another experiment on the Viking Landers, to measure the properties of the atmosphere of Mars.

This experiment grew out of an idea for measuring the atmospheres of the planets by means of probe vehicles during high speed entry, originally advanced in 1962 by A. Seiff of this Center. Now, developed and expanded by Ames research and development, it has led to a set of in-situ measurements to be made on board the Viking entry vehicles which will define for the first time a number of properties of the atmosphere of Mars, at altitudes extending up to 100 km (60 miles).

The PAET flight test was a precursor evaluation and demonstration of the experimental techniques to be used at Mars. These same techniques will be applied by the same investigators on each of the four entry probes of the Ames managed Pioneer Venus Mission.

The experiment is called the Viking Atmosphere Structure Experiment, and it is one of three separate investigations which have been prepared by members of the Viking Entry Science Team. Team Leader is Professor Alfred Nier of the University of Minnesota. Team members are A. Seiff (ARC), W. Hanson (U. of Texas), Michael McElroy (Harvard), and N. Spencer (GSFC). Professor Nier is lead investigator for measurements of the composition of the upper atmosphere, above 100 km, by use of a mass spectrometer. Professor Hanson will measure the number densities and energies of ions and electrons behind the planetary bow shock wave and in the ionosphere, and identify the ions, by means of a Retarding Potential Analyzer. Mr. Seiff is lead investigator for the Atmosphere Structure Experiment, described below. Professor McElroy and Mr. Spencer are Team theoreticians, with Mr. Spencer's area of specialization being mass analysis of the atmosphere.

The primary objective of the Atmosphere Structure Experiment is to determine the profiles of atmospheric temperature, pressure, and density with altitude, by combined use of accelerometers, pressure and temperature sensors, and a radar altimeter. Vertical and horizontal wind velocity determinations will be made from these same instruments, supplemented by the guidance system gyros and a Doppler radar used to guide the spacecraft to a soft landing. The mean molecular weight of the lower atmosphere will be deduced from the data, as will the terrain profiles under the landing track; and the acceleration due to gravity at the landing site will be measured to define the planetary radius there, and thus the elevation of the landing site relative to the mean radius.

These data will respond to some of the outstanding questions concerning the atmosphere of Mars. The state properties (temperature, pressure) have been deduced for altitudes below 45 km on earlier Mariner missions, from remote sensing, but the data show large scatter (or variability), and indicate that the atmosphere cools below the condensation temperature of its principal constituent, CO_2, above 30 km altitude, an unlikely result. The mean surface pressure has been deduced from flyby and orbiter observations to be 6 mb (0.6% of that on Earth). Based on these data and independent measurements of the quantity of CO_2 present, it has been concluded that the atmosphere is at least 90% CO_2. However, there are some recent indications, from Earth-based spectroscopy and the short-lived Russian entry probe, Mars 6, that substantial amounts of argon may be present – 30% to 70% of the atmosphere – which would be consistent with a potassium fraction in the planet's crust comparable to that in the Earth's crust. These and other first order questions on the nature of the atmosphere of Mars should be resolved by the experiment.

The winds on Mars are apparently very stong, fast enough to raise plant-wide dust storms, in spite of the tenuous atmosphere. (This remains to be understood.) The winds are also instrumental in transporting large quantities of solar heat from the equator to the poles. Present knowledge of the winds is, however, very sketchy, and almost entirely based on numerical modeling rather than measurements. The Atmosphere Structure Experiment is expected to yield data on the velocities and their profiles with altitude above the two landing sites, against which the numerical models can be compared and validated, or adjusted, for more confident extension to the rest of the planet.

The Experiment is carried on the two Viking landers of the A and B Missi[illegible]. These are launched 10 days apar[illegible] the landing times are 60 days apart, and the landing latitudes are nominally 20°N and 44°N, both in the summer hemisphere.

Ames personnel who have played an active part in developing this Experimen[illegible] and evaluating the instruments includ[illegible] Si Sommer, Donn Kirk, Robert Corridan, Peter Intrieri, Murray Gardner, and Steve Hing. The Walter V. Sterling Company, under Ames R & QA, has supported the experiment preparation significantly by running numerous tests of the instruments.

US/USSR meeting at Ames

A ten-day meeting between U.S. and U.S.S.R. space officials at Ames began August 18 with an agenda covering medical and biological aspects of spaceflight.

The U.S./U.S.S.R. working group for space biology and medicine is part of the agreement on cooperation in space signed in 1972 by President Nixon and Chairman Kosygin. The group has met on five previous occasions, alternating their missions in each country.

The co-chairmen of the joint meeting are Dr. D.L. Winter, Director of Life Sciences for NASA and Dr. N. Gurovsky of the Ministry of Health of the U.S.S.R.

In the photo above are the U.S./U.S.S.R. space officials. They are (left back to front) Dr. A.M. Glotov, Dr. E.A. Savina, Dr. R.A. Tigranyan, Dr. I.I. Bryanov, Dr. A.V. Yeremin, Dr. N.N. Gurovsky, Mrs. G. Ya. Tverskaya, Dr. N.M. Rudniy, Dr. E.A. Ilyin, Dr. Y.M. Svirezhev, and Mr. N.S. Novikov. Right back to front are Mr. R. Lavroff, Dr. R.C. Simmonds, Dr. A.E. Nicogossia, Dr. L.F. Dietlein, Dr. H.P. Klein, Dr. R.R. Hessberg, Dr. D.L. Winter, Mr. R.S. Johnston, Dr. J.C. Sharp, Mr. L.P. Chamber, Dr. H Sandler, and Mr. P.A. Thibideau.