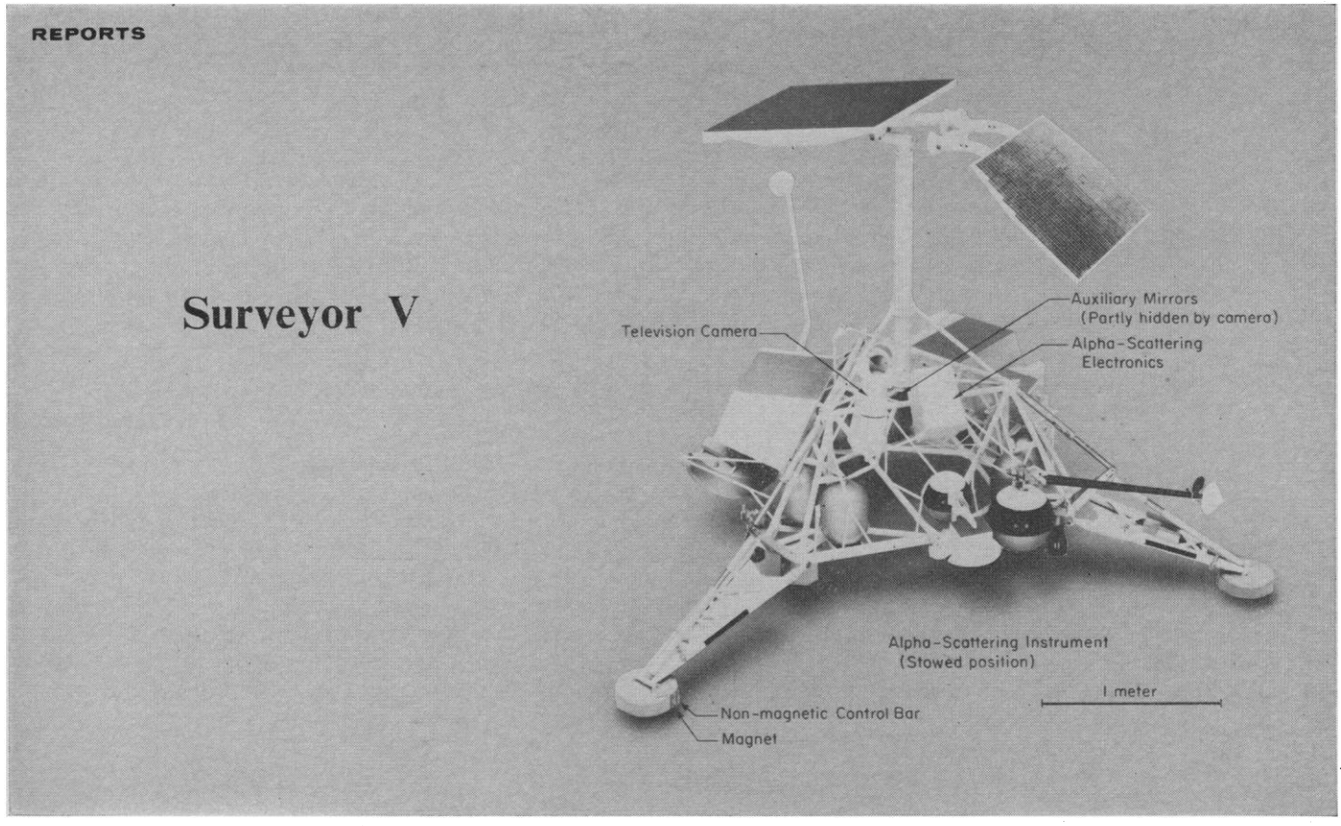

Fig. 1. Model of Surveyor V spacecraft in landed configuration.

Abstract. *Surveyor V has provided the first direct chemical analysis of the lunar surface. In addition, the amount of ferromagnetic material was measured. More than 18,000 television pictures were taken, and a variety of scientific data were obtained.*

Surveyor V was launched from Cape Kennedy, Florida, at 07:57:01 GMT on 8 September 1967. On 8 and 9 September, several midcourse maneuvers were performed. The spacecraft landed in the southeast portion of Mare Tranquillitatis on 11 September 1967, at 00:46:44 GMT. The preliminary position, determined from radio tracking data during flight, is 23.29°E, 1.49°N.

The spacecraft touched down with a vertical velocity of about 4.2 meters per second and a horizontal velocity less than 0.5 meter per second on the southern slope of a crater about 9 meters in diameter and 1.5 meters deep. One leg touched near the top of the slope; the other two legs touched lower down about 0.2 second later. Surveyor then slid a short distance downslope. The footpads visible to the television camera plowed furrows in the lunar soil; one of these furrows is about a meter long and 10 to 15 centimeters deep. The Surveyor came to rest at an angle of about 20 degrees from the local vertical.

Surveyor V (Fig. 1) is generally similar to Surveyor I (*1*), but it carries an alpha-particle backscattering experiment for chemical analysis of the lunar surface (*2*). A bar magnet and a nonmagnetic control bar were attached to one of the footpads to indicate the presence of ferromagnetic material in the lunar soil. Two convex auxiliary mirrors located low on the spaceframe permitted better viewing of the lunar surface below the alpha-scattering instrument, a vernier engine, and a crushable landing block.

Surveyor V took 18,006 television pictures from 11 to 24 September 1967. These pictures included views of the interior of the crater in which the spacecraft rests, pictures of the rather level mare surface surrounding the crater, star and planet sightings for attitude reference, and a sequence of solar-corona pictures made after local sunset. The liquid-propellant vernier engines were fired for 0.55 second at 05:38 GMT on 13 September to provide information on the effects of engine exhaust upon lunar surface material. The alpha-scattering instrument accumulated data for about 82 hours during the period to 24 September, giving the first direct information on the chemical composition of the local material. Views of the magnet assembly also provided good data. Information was obtained on mechanical properties of the lunar surface material, surface temperatures during lunar day and evening, local radar reflectivity, and radial velocity of the landing site relative to Earth as a function of time.

Some of the significant early findings are given in the papers which follow.

LEONARD D. JAFFE
ROBERT H. STEINBACHER
Jet Propulsion Laboratory, Pasadena, California

References and Notes

1. Surveyor Scientific Evaluation Advisory Team, *Science* **152**, 1737 (1966); L. D. Jaffe, *J. Geophys. Res.* **72**, 773 (1967).
2. A. L. Turkevich, K. Knolle, R. A. Emmert, W. A. Anderson, J. H. Patterson, E. Franzgrote, *Rev. Sci. Instr.* **37**, 1681 (1966); A. L. Turkevich, K. Knolle, E. Franzgrote, J. H. Patterson, *J. Geophys. Res.* **72**, 831 (1967).
3. This paper presents the results of one phase of research carried out at the Jet Propulsion Laboratory, California Institute of Technology, under Contract No. NAS 7-100, sponsored by the National Aeronautics and Space Administration.

9 October 1967