THE RESULTS OBTAINED FROM RANGER VII

An exceptional meeting was scheduled on Monday 31 August 1964 at 15^h 30^m in the Auditorium Maximum of the Hamburg University, in order to allow astronomers to hear direct reports from the American scientists on the results obtained from the photographic close study of the Moon surface, by the space vehicle Ranger VII, flown on 1964 July 28, at 16^h 50^m U.T. Ranger VII has sent 4316 images from 13^h 08^m U.T. on 1964 July 31, obtained from six different cameras, from altitudes ranging from 1377 miles to 1000 feet above the Moon surface, just before Ranger VII finally crashed on the Moon surface.

Le Professeur V. A. Ambartsumian, Président de l'UAI, après quelques mots d'introduction, confie la présidence de cette séance exceptionnelle au Dr Urner Liddel, Lunar and Planetary Programs, NASA.

Le Président présente les différents orateurs qui exposent devant une salle comble les divers aspects des problèmes posés par l'expérience spatiale Ranger VII du 31 Juillet 1964.

1. *U. Liddel.* Introductory Remarks
2. *H. M. Schurmeier, R. L. Heacock, B. P. Miller.* The Ranger VII mission
3. *G. M. Smith, D. E. Willingham, W. H. Kirhofer.* Ranger VII camera calibration and performance
4. *G. P. Kuiper, E. A. Whitaker.* Presentation of Ranger VII Moon images
5. *G. P. Kuiper.* The surface of the Moon
6. *E. M. Shoemaker:* Interpretation of the small craters of the Moon's surface revealed by Ranger VII.

1. INTRODUCTORY REMARKS

U. Liddel

(National Aeronautics and Space Administration, Washington, D.C., U.S.A.)

The Moon on its course around the Earth has traveled but a few miles more than one revolution since its surface has been examined by the newest telescope devised by the minds of men. Ranger VII was an unusual telescope. It had six objective lenses, and the 'eyepiece' was a television screen. I am sure that it is but the first member of a new series of telescopes by means of which man will study the Universe.

The United States National Aeronautics and Space Administration is honored and proud to cooperate in the presentation of the results of these observations to this General Assembly of the International Astronomical Union. It is impossible to give credit to all the many persons, in addition to those authors whose names appear on this program, who made Ranger VII successful. I will mention only one, Mr Cunningham, who 'god-fathered' the program as Program Manager in NASA Headquarters. Suffice it perhaps to say that the spacecraft was built and launched by the Jet Propulsion Laboratory which is managed by the California Institute of Technology for the National Aeronautics and Space Administration.

And now I have the great honor to present the first album of initial photographs of the Moon taken by the Ranger spacecraft to the Director of the Observatory of our host University, Prof. Haffner. Other albums will be distributed to Directors of the major observatories throughout the world.

The first paper will be presented by Mr Schurmeier, Project Manager, who bore the responsibility for its operation with broad and capable shoulders.

2. THE RANGER VII MISSION

H. M. Schurmeier, R. L. Heacock

(Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, U.S.A.)

and

B. P. Miller

(Astro-Electronics Division, Radio Corporation of America, Princeton, New Jersey, U.S.A.)

The Ranger system uses an attitude-stabilized spacecraft to get the advantages of maximum solar power generation; maximum communications capability; spacecraft-centered coordinate system for use in midcourse maneuvers; and direction and control capabilities for accurate scientific instrument observations. Ranger also utilizes the parking orbit technique, permitting maximum payload to be efficiently injected into the desired trajectory.

In spite of the Ranger Blocks I and II launch vehicle and spacecraft system problems, valuable knowledge and experience was gained and applied to Mariner II and Rangers VI and VII. The results of these missions included an extremely successful fly-by of Venus and two lunar impacts of pinpoint accuracy.

Block III of the Ranger program differs from Block II only in the payload which consists of fast sequence-shuttered TV cameras operating into two high-power transmitters.

Ranger VI failed to return pictures because of power supply destruction due to unscheduled turn-on of the TV system during launch.

The Atlas D/Agena B multistage launch vehicle was employed for the mission. Major constraints on the flight plan were (*a*) Earth-Moon geometry must be such that the spacecraft has adequate orientation accuracy during flight; (*b*) lunar lighting conditions must provide contrast for good pictures; (*c*) lunar encounter must be effected during Goldstone view period.

Launch window is about 2 hours per day of a 6-day launch period each month.

The spacecraft itself is hexagonal in shape. Power is supplied by both batteries and solar panels. Telecommunication subsystem includes antenna, radio, command and telemetry subsystems. The Guidance and Control system consists of central computer and sequencer and the autopilot and attitude control units. Propulsion for the midcourse maneuver is a monopropellant system using hydrazine. Temperature control is achieved through passive techniques. Explosive actuators are used in deploying solar panels and controlling the midcourse motor.

Six cameras, associated control and video circuitry, power system, and transmitters make up the TV subsystem. The two basic camera lenses are a 25 mm $f/1{\cdot}0$ and a 76 mm $f/2{\cdot}0$. Photo-