there have been accumulated many mutations which are relatively innocuous, in the physiological sense, but which cause sufficient diversity of genetic structure to prevent the necessary pairing over short distances prior to recombination. It may therefore be expected that individual differences relative to the "interspecific" transduction efficiency of different genes may exist, some genes being more efficiently transduced than others.

References

1. L. S. Baron, W. M. Spillman, N. F. Carey, *Science* **130**, 566 (1959).
2. T. Miyake and M. Demerec, *Nature* **183**, 1586 (1959).
3. L. L. Cavalli, J. Lederberg, E. M. Lederberg, *J. Gen. Microbiol.* **8**, 89 (1953).
4. W. Hayes, *Cold Spring Harbor Symposia Quant. Biol.* **18**, 75 (1953).
5. J. Lederberg, *Methods in Med. Research* **3**, 5 (1950).
6. J. Lederberg, E. M. Lederberg, N. D. Zinder, E. Lively, *Cold Spring Harbor Symposia Quant. Biol.* **16**, 413 (1951).
7. N. D. Zinder and J. Lederberg, *J. Bacteriol.* **64**, 679 (1952).
8. N. D. Zinder, *J. Cellular Comp. Physiol.* **45**, 23 (1955).
9. S. E. Luria, *Cold Spring Harbor Symposia Quant. Biol.* **18**, 237 (1953).

Science in the News

United States Satellite Launched into Orbit around Sun

The United States has placed a 94.8-pound satellite, Pioneer V, in orbit around the sun between Earth and Venus (see diagram). The spherical, 26-inch aluminum payload, which was launched by a three-stage rocket on 11 March, will take 311 days to complete a circuit of the sun.

The vehicle carries instruments for five experiments, the most significant device being a 150-watt transmitter designed to permit communications between Earth and the payload at distances of up to 50 million miles. The transmitter is believed to be the most powerful ever flown in deep space—approximately 30 times more powerful than any other United States experimental space transmitter developed to date.

The launching is the third in a series of "paddle-wheel" flights. The National Aeronautics and Space Administration contracted for the series in November 1958 with the Air Force Ballistic Missile Division (Air Research and Development Command). In turn, AFBMD subcontracted with Space Technology Laboratories, Inc., of Los Angeles, for over-all system integration and payload packaging. In all, some 50 subcontractors, including universities and industrial firms, have had a part in the series.

The new satellite, which was propelled at more than 24,869 miles an hour at third-stage burnout, is designed to describe a 506-million-mile path around the sun at an average speed of about 70,000 miles an hour.

This probe differs from past successful sun-orbiting probes—the Soviet Union's Lunik I (2 January 1959) and the United States' Pioneer IV (3 March 1959)—in that it is inside the earth's orbit. Lunik I and Pioneer IV are in orbits between those of Earth and Mars.

To get it into an orbit between Earth and Venus, Pioneer V was launched in the morning. As the rocket neared escape velocity, it followed the curve and directional spin of the earth. When it escaped, the vehicle was swept into a sun orbit by the sun's gravitational force; it is moving around the sun in the same direction as the rest of the planets.

Significance of the Transmitter

There are several reasons for sending up the powerful transmitter. One objective is to demonstrate the feasibility of long-range space communications. Another involves a new method of measuring astronomical distances.

To date, distances within the universe have been computed from basic laws of physics governing bodies in motion, with positions plotted against seemingly stable distant stars. To astronomers, the basic unit of measurement is the AU or astronomical unit—the mean distance between Earth and Sun, or approximately 93 million miles.

Most scientists agree that this measurement is accurate to only plus or minus 50,000 miles. It is important to future space missions to have more precise values. Successful long-range communication with this payload should provide a more accurate measure. The transmitter and associated electronic equipment, batteries, and the solar cells for power supply make up more than half the probe's total weight.

Other Instrumentation

A high-energy radiation counter, developed by the University of Chicago, measures high-energy or "hard" radiation, particularly from the sun.

An ionization chamber and a Geiger-Müller tube, together weighing about 2 pounds, are measuring the total radiation flux encountered. They are particularly sensitive to medium-energy radiation. These instruments were supplied by the University of Minnesota.

A 1-pound micrometeorite counter, developed by the Air Force Cambridge Research Center, is measuring the number and momentum of meteoric dust particles striking the probe.

A 1-pound search-coil magnetometer, developed by Space Technology Laboratories, is designed to determine the strength and direction of magnetic fields in space.

An 8-ounce photoelectric cell called an "aspect indicator," also developed by STL, will trigger a specific electrical impulse when it "looks" directly at the sun. These "fixes" on the sun should make the information obtained from the magnetometers and radiation counters more meaningful.

In addition to the instruments listed, Pioneer V contains a number of amplifiers, "logic" units which transform various instrument-sensing actions into transmittable signals, and a command compartment capable of initiating some ten payload functions. Five tiny thermistors are recording temperatures, two on the paddles and three within the payload.

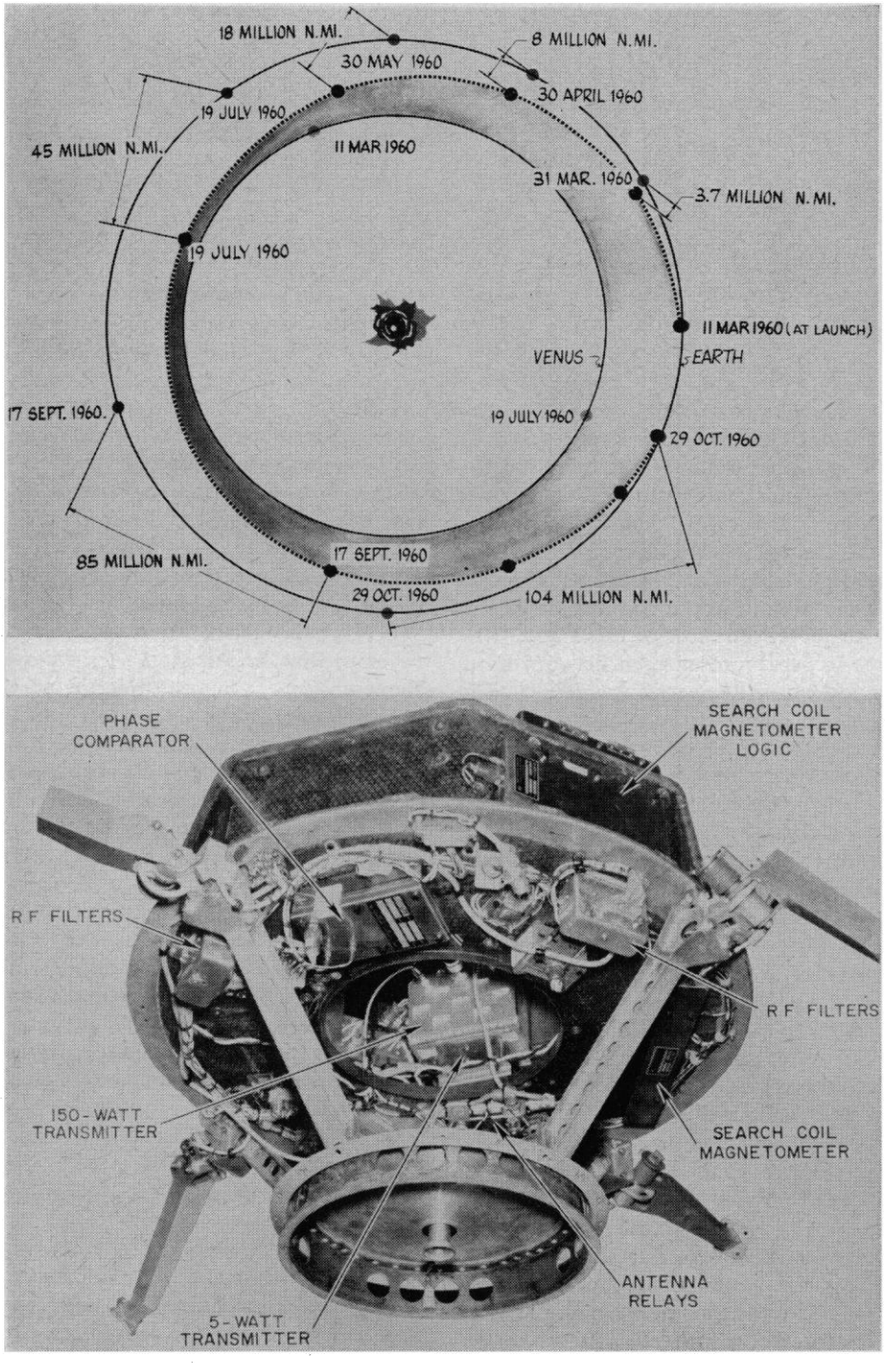
Radio Contact

The probe carries one 5-watt ultra-high-frequency transmitter which, on

command, becomes an amplifier for the 150-watt transmitter. Both transmitters are connected to all instrumentation, but only one transmits at a time. The frequency is 378 megacycles per second.

The satellite is silent (to conserve power) until a transmitter is activated by one of three ground stations. The stations are located at South Point, Hawaii, at Goldstone Lake, Calif., and at Jodrell Bank in England. The instruments function even when the transmitters are not operating; their findings are stored in electronic accumulators for later transmittal. Radio power is supplied by mercury batteries that are kept charged by solar cells in the four paddles.

It is expected that periodic radio contact can be maintained with Pioneer V for at least the next 5 months, until it goes out of range. If the vehicle's instruments hold up under the stresses of space environment, radio contact might be reestablished in 1963, when the satellite is expected to come within 50 million miles of the earth again.



(Top) Plot of the projected path of Pioneer V in relation to the earth and Venus in the months ahead. (Bottom) View of the 94.8-pound probe payload without its aluminum shell. Near the earth, the 5-watt transmitter will be used for relaying experiment information. But when the probe is several million miles away from the earth, the 5-watt transmitter will become a booster-amplifier for the powerful 150-watt transmitter. [National Aeronautics and Space Administration]

Project Officials

Principal NASA officials involved in this program are Abe Silverstein, director of space flight development, and John Lindsay, head of the solar physics program of the space sciences division.

Key Air Force Ballistic Missile Division and Space Technology Laboratories personnel engaged in the program are Maj. Gen. O. J. Ritland, commander of AFBMD; Ruben F. Mettler, STL executive vice president and senior project advisor; Col. Richard D. Curtin, AFBMD deputy commander for Military Space Systems; George E. Mueller, STL vice president, associate director of the research and development division, and senior project advisor; Lt. Col. Donald R. Latham, AFBMD director of space probe projects; Adolph K. Thiel, STL director of advanced experimental space missions and project director; and Major John E. Richards, AFBMD chief of the astrovehicles division within the space probes directorate.

Hearings on Atomic Energy Research Scheduled by Joint Committee

A series of public congressional hearings on "Frontiers in Atomic Energy Research" will be held in Washington 22–25 March, according to Representative Melvin Price, chairman of the Subcommittee on Research and Development of the Joint Committee on Atomic Energy. The hearings will begin with consideration of research in the use of nuclear explosives for peaceful purposes (known as the "Plowshare" project) and then proceed to the program for obtaining power by means of controlled thermonuclear reactions.

After this, the subcommittee will hear testimony on advanced developments in nuclear (fission) power-reactor concepts. Adaptation of nuclear power for outer space propulsion (particularly the "Rover" project) and auxiliary power systems for satellites and space ships (SNAP) will then be discussed. The final session will be devoted to a discussion of direct conversion of nuclear energy to electric power and of the role of solar energy.