

# PROJECT VANGUARD

## — The Earth Satellite Program

by WILLIAM H. PICKERING

ONE OF THE MOST widely known projects in the International Geophysical Year is the Earth Satellite Program, "Project Vanguard." This project is a responsibility of the Naval Research Laboratory in Washington, D. C., but in view of the widespread scientific implications of the program it was almost inevitable that Caltech should have some association with the project.

Direction of the project falls naturally into two areas. The development of the rocket vehicle to put the satellite on its orbit is a responsibility of the Department of Defense and has been given to the Navy. The scientific program associated with the experiment is directed by the U.S. National Committee through its Technical Panel on the Earth Satellite Program.

The scientific program for the satellite experiment has evolved primarily around the experience of those groups which have been active in the upper atmosphere research program of the past ten years. In January, 1956, a symposium held at the University of Michigan resulted in some 30 papers proposing scientific experiments to be performed on a small satellite. During 1956 these proposals were studied by the panel, and, as a consequence, a set of experiments for the first six satellites has gradually evolved.

The first experiment is a measurement of the temperature of the orbiting vehicle. This will establish the environment in the vehicle and the extent to which it has been possible to control temperature fluctuations. Data for this experiment will also give information on the albedo or reflecting power of the earth.

A second experiment associated with the satellite environment is a measure of the effect of small meteoritic particles. It is proposed to make a portion of the satellite pressure-tight, and to observe whether this section develops a leak due to penetration by a meteorite. It is also proposed to place a resistive coating on the outer shell, to determine whether this coating is worn away by erosion from micro-meteorites.

Other experiments on the early satellite flights will include measurements of the Lyman-alpha radiation from the sun and the cosmic ray intensity above the atmosphere, as measured with a Geiger counter. An attempt will also be made to measure the magnetic field of the earth at satellite altitudes with the hope that some information may be obtained as to the presence of current sheets above these altitudes.

A satellite experiment has been proposed by Caltech. This involves contributions from the campus, the Mount Wilson Observatory and the Jet Propulsion Laboratory.



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It would completely instrument one of the vehicles. The primary experiments would be, first, a measurement of the cosmic ray intensity with one of the cosmic ray ionization chambers developed by Dr. H. V. Neher, professor of physics; and second, a photometer experiment proposed by Dr. William Baum, staff member of the Mount Wilson and Palomar Observatories, which would measure the integrated light coming from different parts of the sky. A set of filters would allow the measurement to be made at different wave lengths. An analysis of the data may be of value in distinguishing between different cosmological models. For many years the astronomers have wanted to be able to mount a telescope on a satellite in order to view the sky from outside the earth's atmosphere. This experiment of Baum's is a first step in this direction, and is the only truly astronomical experiment proposed for the IGY satellite.

The instrumentation for these experiments will be provided by the Jet Propulsion Laboratory and will include JPL's Microlock communication system to transmit the data back to the earth. The Microlock system is an exceedingly sensitive phase-locked communication technique which allows the on-board satellite transmitter

to be of very low power and low weight. With a radiated power of 30 milliwatts, there will be no difficulty in tracking the satellite and receiving the transmitted data over ranges of several thousand miles. The transmitter will weigh about two pounds, including its battery for a lifetime of two months. Because of the restrictions in weight of the satellite vehicle, it is very essential to miniaturize all of the satellite equipment as much as possible. Total weight of the Vanguard satellite is limited to 20 pounds.

The Jet Propulsion Laboratory has been interested in satellite problems for many years. Shortly after the war the Laboratory prepared a number of reports on satellite orbits and associated rocket problems. At the time when the IGY satellite was under consideration, each of the Services was invited to make a contribution to the project. The Army submitted a proposal in which the Laboratory played a very significant part. Microlock, which has proved to be exceedingly valuable in many applications, was essentially an outgrowth of this study.

The Caltech experiment is not at present scheduled for one of the early satellites, but it is hoped that there will be an opportunity to carry it out in the near future.