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SCIENTIFIC MISSIONS OF U. S. EARTH SATELLITE

The earth satellite launched by the Army's modified Jupiter-C has as its primary scientific mission the monitoring, measurement and observation of cosmic ray intensity above the atmosphere with respect to time and position.

There are secondary instruments which provide data on the density of micrometeorites, and the temperature inside and outside the satellite.

The satellite launching, assigned to the Army as a part of the U.S. effort in the International Geophysical Year, is a joint project of the Army Ballistic Missile Agency, Huntsville, Ala., and the Jet Propulsion Laboratory, Pasadena, Calif. There will be an unannounced number of Army firings using the modified Jupiter-C, which was originally a re-entry test missile.

The cosmic radiation experiment was designed by Dr. James A. Van Allen and his physics students at the State University of Iowa. Dr. Van Allen is chairman of the SUI physics department.

The Iowa experiment is similar to that flown by Dr. Van Allen in hundreds of sounding rockets in the past 12 years.

It consists essentially of a single Geiger counter, the same instrument that is used for uranium prospecting and for all types of radioactivity measurement. It is a simple device, and has made a number of outstanding contributions to science since it was invented in Germany nearly 40 years ago.

Data is being transmitted from Army-launched satellites in two methods. The first satellite launched sends out radio signals to receiving stations distributed over much of the equatorial band covered by the satellite. The data, however, will not be completely representative of the total orbit since some of the band will not have receiving stations. Especially is this true over large bodies of water.

The cosmic radiation apparatus furnishes information which can be used for several scientific studies, such as:

1. Determination of the effective geomagnetic field.

2. Correlations between primary cosmic ray and solar and magnetic observations.

3. The magnetic rigidity spectrum of the primary radiation.

A second experiment in the Army satellite package measures meteorite density. This experiment was prepared by the Air Force Cambridge Research Center, Geophysics Research Directorate.

The impact of, and the erosion caused by, small meteoritic particles is measured in two ways.

The first instrument is an impact microphone which will pick up the sound of actual impacts of small particles colliding with the satellite shell anywhere on its surface. This measurement gives indications of the numbers of particles within a certain

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momentum range.

Exterior erosion gages compose the other instrument. In a ring mounted on the outside of the shell are several coils wound with extemely fine wire, electrically connected in parallel.

If one of the grid-wires is hit by a particle physically large enough to break the wire, the overall resistance of the string will change in a step-wise manner. Also included in the set of gages is one composed of a very thin film of resistive material. The total resistance of this gage will change slowly as the material is removed by the "sandblasting" action of cosmic dust traveling at a very high velocity.

A third and final type of information is temperature readings both inside and outside the shell. This experiment was prepared by the Jet Propulsion Laboratory, Pasadena, Calif. Thermometers placed well into the interior of the satellite and next to the outside skin -- between the exterior shell and the insulation material -- provide this information.

In successive passes from the sunlit to the shady side of the earth, the outer skin of the satellite is subjected to temperatures ranging from about 100 degrees F. to about 70 degrees below zero. Insulation is expected to reduce this cycle in the instrument package to limits of 40 and 70 degrees F, according to calculations by Dr. Van Allen.

Total weight of the scientific instrumentation is about 11 pounds. The shell of the package is almost completely filled with

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the two radio transmitters and their batteries, plus the scientific experiments.

The satellite was launched to orbit at approximately 20 degree angle to the equator. This orbit keeps it circulating overhead in a zone between the 35th latitudes North and South. At the orbital velocity of 18,000 miles per hours, the vehicle will circle the earth in about 100 minutes, or 14 to 16 times a day.

Over a sufficiently long time the satellite will come at least once within sighting distance of everyone within the orbital band, covering about 125,000,000 square miles of the earth's surface. The casual observer will not likely be able to see it with the naked eye. Except under rare conditions, it will require low-power magnification.

One reason for selecting a lateral orbit around the earth was to take advantage of the earth's rotation to help launch the satellite. The rocket was launched from Cape Canaveral, Fla., toward the east over the Atlantic Ocean. The earth's eastward rotation added, by a kind of slingshot effect, to the velocity given the satellite by the rocket motors.

The launching set the stage for the nerve-wracking task of the first sighting of the satellite. Down-range observation of the departing rocket predicted the arrival of the satellite over a given observation point with a possible error of several minutes and hundreds of miles.

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In some cases there may be some doubt that the satellite is actually in a durable orbit. The number of fully equipped optical observatories is limited. Their coverage is supplemented by amateur observers all over the world, each assigned his own area of observation.

Fortunately, location of the orbiter does not depend solely on observation. Two small radio transmitters emit steady signals. One of them can be received only by special equipment, but ham radio operators the world over can tune in on the other.

Once the satellite had been sighted and its first few orbits plotted, future passes could then be predicted with increasing accuracy.

The primary optical observations will be conducted from 12 specially equipped stations. Each of them have a 20-inch object at 1,000 miles, or a three-foot object at the distance of the moon.

These cameras will take a series of exposures of each passage on strip film. On these pictures the satellite can be located within a minute or two of arc in the sky and within milliseconds in time. Such precision will make it possible, according to Dr. Van Allen, to locate observing stations relative to one another and to center of the earth to an accuracy of 30 to 50 feet.

A dozen of such fixes will allow geographers to connect the maps of the continents with new accuracy and will help to establish the shape of the earth.

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