bursts of signals. Particular attention will be paid to Jupiter, long known as a source of radio bursts, and to the sun's role in low-frequency radio storms on the earth. Simultaneous observations will be made on the earth at higher frequencies for later correlation with the satellite data.

Robert G. Stone of the Goddard Institute for Space Studies is the principal investigator. The satellite transfers its data to five ground stations in real time when it is within range; at other times the data are stored on a tape recorder for later transfer to a ground station. Tapes made on the ground are flown to Stone at Greenbelt, Md.

The satellite, known as Radio Astronomy Explorer-A, is expected to operate for about a year. A second is to be launched next year. Space officials hope to have both in orbit as the sun passes through the maximum of the current 11-year solar-activity cycle.

Relativistic Perihelion Shift Refined after Icarus Approach

The asteroid Icarus passed within 6 million km of the earth on 14 June and was studied as never before in the 19 years since its discovery. Its highly eccentric orbit makes it suitable for studying the relativistic precession of its perihelion, and its small size and close approach to the earth allow accurate determination of its position.

Radar contact was made from MIT's Haystack Microwave Research Facility in Tyngsboro, Mass., and the Goldstone station of the Deep Space Network in California's Mojave Desert. Optical observations were made around the world.

The MIT team headed by Irwin I. Shapiro reported that their radar returns were disappointingly weak. Rain reduced the effectiveness of their radar (transmitting at 8 GHz); the returns were near the lower end of the range of possible echo strength calculated in advance. California results (at 2.4 GHz) also were disappointing.

Optical observations, however, fared better. About 100 positions were recorded, compared with the 71 that had been gathered in the previous 19 years. These positions are being forwarded to Shapiro, and during the next few months they will be analyzed by computer.

Shapiro hopes to reduce the standard error in the coefficient of the relativistic terms in the equations of motion. Prior to the June passage of Icarus, this coefficient was computed at 0.97 ± 0.20; it is hoped to reduce the error to 0.09. A coefficient of 1 corresponds to general relativity while 0 corresponds to Newtonian theory.

PROTON CHANNELING IN SILICON. R. Stuart Nelson (AERE Harwell) used ordinary color film (Agfa CN-17) as an energy analyzer to obtain this picture of 1.5-MeV protons that have passed through a silicon single crystal 30 microns thick. Randomly scattered protons lose some energy in the crystal and are stopped in the yellow emulsion of the film; protons that traverse the crystal along preferred crystal-plane directions known as "channels" lose less energy and can penetrate to the next emulsion layer to yield a red image. Total film thickness is 20–22 microns. Asymmetry in the pattern is caused by a 3-deg tilt of the film plane with respect to the 100 plane of the crystal. The method is reported in *Journal of Materials Science* 2, 171 (1967).

IN BRIEF

Two new pulsars reported by Anthony Hewish at Cambridge (CP 0808 and CP 0328) and two discovered in Australia by the Sydney University Mills Cross bring the total to nine. Periods are 1.29 and 0.71 sec for the northern ones and 0.56 and 1.96 sec for the Sydney pulsars.

ACCELERATORS

The cyclotron–tandem Van de Graaff combination 30-MeV accelerator at Triangle Universities Nuclear Laboratories in North Carolina is undergoing tests of the components. If the schedule is maintained the machine will be ready for testing as a unit by 1 Nov. One design change, insertion of a bending magnet between the cyclotron and the accelerator, is not expected to delay completion.

Another "Cyclo-Graaff" will be assembled at the Lawrence Radiation Laboratory in Livermore, Calif. The Cyclotron Corp. will provide a 15-MeV negative-ion injector for an existing tandem accelerator, to be operational early in 1969.

Ohio University has ordered an 11-MeV high-intensity tandem Van de Graaff accelerator system under a $1 million Atomic Energy Commission grant. It will provide a proton beam intensity of 25 microamperes in continuous operation and up to 2000 microamp pulsed.

Ten tons of nuclear-research equipment has been airlifted from Geneva to Serpukhov in the Soviet Union. It will be used in a collaborative experiment by Soviet and CERN scientists in one of the first experiments on the newly commissioned 76-GeV proton synchrotron at Serpukhov. The equipment includes a fast-ejection system and radio-frequency separator. □