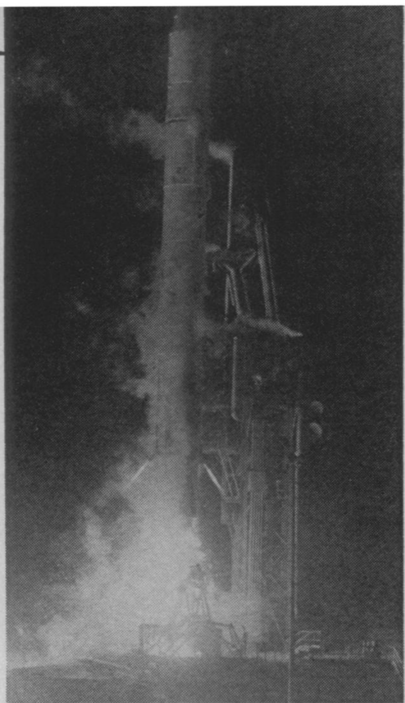
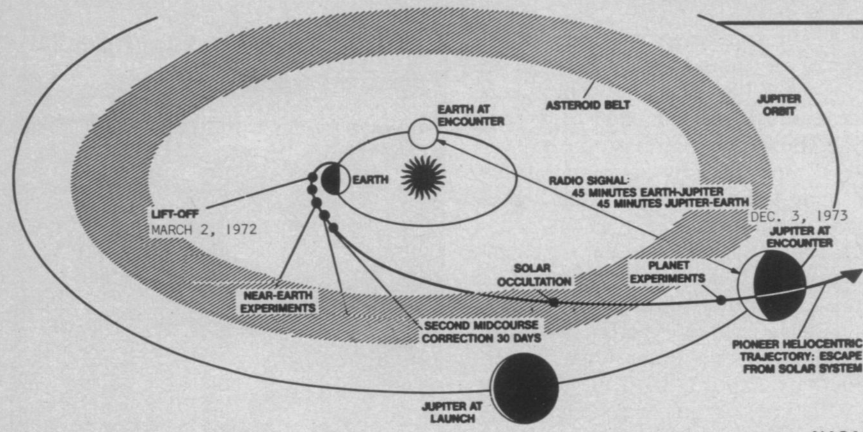
Two nuclear engines have been tested, a miniature steam engine and a modified Stirling engine. The nuclear energy source is about 100 grams of plutonium 238. The engine is encased in a three-layer metal capsule that is designed, says Harmison, to withstand "incredible accident conditions." The prototype engine, designed for test implantation in a calf, is a cylinder weighing about 2.5 kilograms and measuring 7.6 by 20 centimeters. The human version, to be implanted in the abdomen, would be slightly smaller. Ultimately, says Harmison, it might be reduced sufficiently in size to be put between the ventricles of the artificial heart. The engine could be used to power a total replacement heart or a heart-assist system.

The implantable artificial heart, similar to the natural heart in general structure, can be powered either by the nuclear engine or by electricity. A heart-assist system with the nuclear engine was implanted in a calf in mid-February to verify the procedure for implantation; the artificial heart, powered electrically, has also undergone short-term tests in animals. No long-term tests have been done yet. This will be the next step. Harmison estimates that nuclear-powered artificial hearts might become available for use by humans by the end of this decade. The cost of implantation would be comparable to that for a transplant, but long-term follow-up costs would be less. The system will be designed to operate for 10 years.

The NHLI researchers emphasized that much remains to be done. The long-term animal studies will have to determine: the reaction of the rest of the body to the system; the responsiveness of the system to changing physiological needs and instantaneous energy demands; the effects of excess heat emitted by the system on surrounding tissue. In addition, says NHLI head, Theodore Cooper, a great effort has been and will be devoted to the economic, sociological and psychological implications of the device. □



Pioneer 10 begins journey to Jupiter



NASA

Pioneer 10 begins journey through the asteroids to Jupiter and beyond.

Pioneer F (renamed Pioneer 10 after launch) finally got off on its 22-month journey to Jupiter March 2 after a four-day delay. The launch was delayed three nights by shear winds above Cape Kennedy and one night by an Air Force launch.

Other planetary payloads have been launched, but Pioneer 10 has a special ring to it (SN: 11/13/71, p. 330). It will be the first craft to navigate through the asteroid belt (beginning in early July), and on to a rendezvous with Jupiter Dec. 3, 1973. It will then cross the orbit of Uranus in 1980 and at some point beyond the orbit of Pluto (about 5.8 billion kilometers from the sun) leave the solar system. Carl Sagan and Frank Drake of Cornell University estimate that with a residual interstellar velocity of 11.5 kilometers per second, it will take Pioneer 10 some 80,000 years to travel one parsec—about the distance to the nearest star. After mid-course correction burns early this week, Charles F. Hall, project manager of Pioneer, said the craft would exit the trailing edge of the solar system (in relation to the solar system's direction of rotation within the Milky Way galaxy). It is thought now that the craft will be headed in the general direction of the star Aldebaran. Should Pioneer 10 head for that star, it would take an estimated 1.7 million years to get there.

The spacecraft carries a plaque designed to show any intelligent civilization from another system that might intercept Pioneer 10 from what part of the galaxy and from which planet in the solar system it came and when it was launched (SN: 2/26/72, p. 135).

The Jupiter probe left earth at a speed of 51,800 kilometers per hour—the fastest that any manmade object has ever flown. It passed the moon in 11 hours.

As a result of this week's mid-course corrections, Pioneer 10 is expected to pass within 135,000 kilometers of the surface of Jupiter and within 400,000 kilometers of Io, 300,000 kilometers of Europa and 500,000 kilometers of Ganymede, all moons of Jupiter. Three instruments aboard recorded data as the craft went through the earth's radiation belts and crossed the boundary of the earth's magnetic field.

A hexagonal surprise in superconductivity

It took 50 years after the experimental discovery of superconductivity for theoretical physicists to reconcile the phenomenon with the laws of physics. There is still no reliable theory that predicts where and when superconductivity should appear, and its appearance occasionally surprises experimenters.

Such a surprise has come to a group working at Bell Telephone Laboratories in Murray Hill, N.J. The investigators, H. E. Barz, A. S. Cooper, E. Corenzwit, M. Marezio, B. T. Matthias (also of the University of California at San Diego) and P. H. Schmidt, have found superconductivity at quite high temperatures in lithium titanium sulfides. It was, reports Matthias, "an entirely new and quite unexpected phenomenon."

The transition temperatures for complete superconductivity in these compounds ranged between 10 and 13 de-