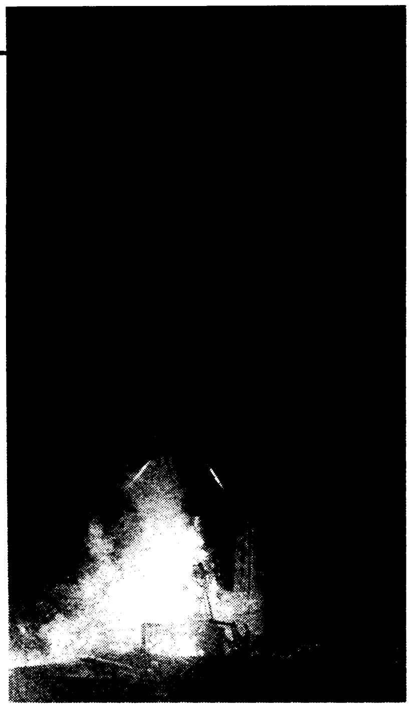

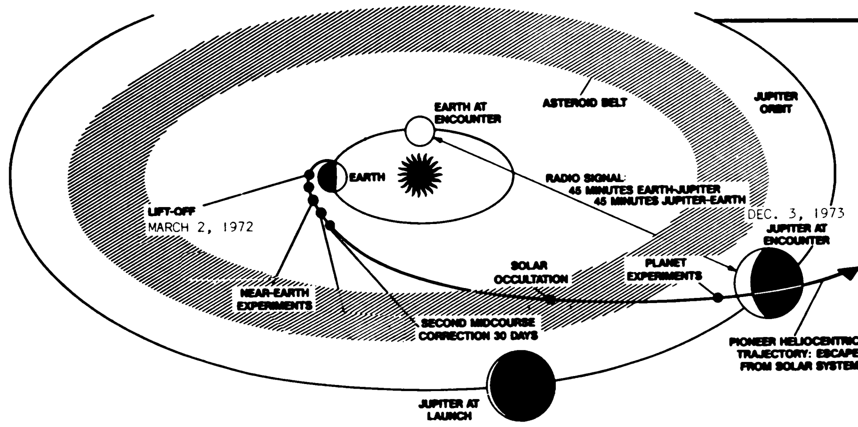

NASA

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

Pioneer 10 begins journey to Jupiter

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.

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. □

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-

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grees K.; in some cases superconductivity began at temperatures as high as 15 degrees. Two-element compounds of these substances are not superconducting above one degree so the experimenters were entirely unprepared for such high temperatures in the three-element compounds.

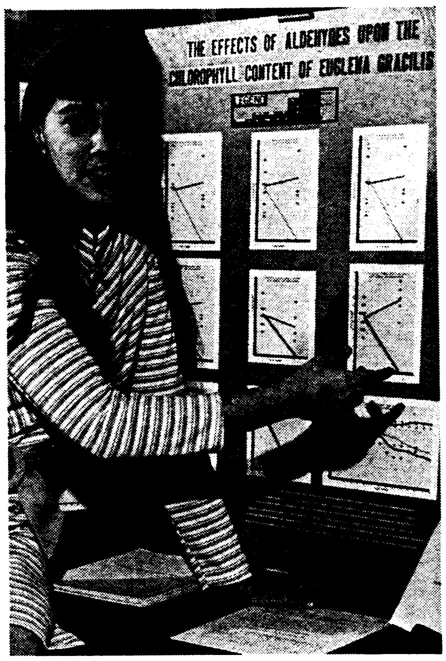
The compounds are similar in chemical constituents to the intercalation or layered compounds that other experimenters have used in experiments aimed at producing two-dimensional superconductivity (SN: 9/4/72, p. 140), but the Bell Labs group says that they should not be considered intercalation compounds: They are "just the opposite," says Matthias, "a clear-cut three-dimensional array." Crystallographically they have a hexagonal structure, another surprise: They are the first noncubic structures to have such high transition temperatures.

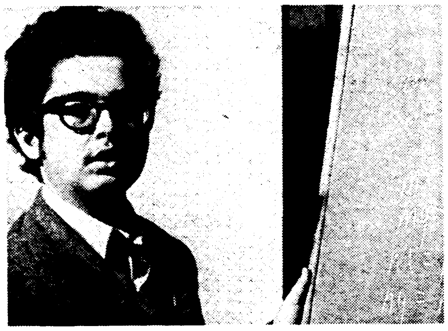
The discovery of superconducting lithium titanium sulfides was announced in the Feb. 25 SCIENCE. Since that paper was submitted, work has shown that there is an "enormous variety of similar compounds," says Matthias. "We have made a great number, and all [transition temperatures] are that high or higher." He expresses optimism that work with the compounds will lead to transition temperatures somewhat higher than the present upper limit of 21 degrees K.

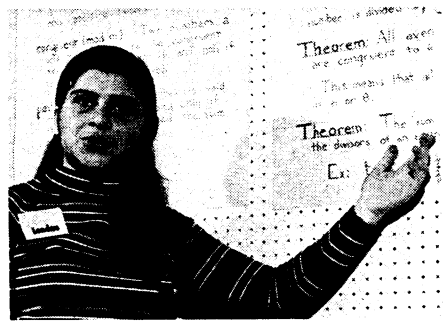
How high transition temperatures may go is not yet clear, but Matthias is not predicting any spectacular increase. There are optimists who believe that substances can be found or manufactured with superconducting transition temperatures up to and including the room-temperature range. (This would make the use of superconductors in electrical devices more practical because it would remove the technological difficulties and the cost of the extreme refrigeration now necessary.) Matthias has always been scornful of such ideas, and the debate between him and the high-temperature proponents is often acrimonious. He does not expect the current experiments to lead to anything much above the extreme cryogenic range where superconductivity is now found.

But these are higher transition temperatures than usual, and why they should appear in these substances remains to be set out in detail. One idea considered at first was that the crystallographic instability of the Li-Ti-S compounds had something to do with it. Since then, says Matthias, "we have found a way to create a certain metastability that is good enough," and the instability doesn't seem so important anymore. As the work progresses other ideas are forming, and the group hopes to be able to publish something soon. □

Five of top 10 science talent winners females







Science scholarship winners: (clockwise) Tabachnik, Horowitz and Landau.

Several trends were evident in this year's Westinghouse Science Talent Search—the number of female winners and the amount of independent research in environmental effects on living organisms.

Nina Felice Tabachnik, a composer, musician and published poet from Benjamin N. Cardozo High School in Bayside, N.Y., was judged the nation's top high school scientist. She was one of 10 scholarship winners selected from 40 semifinalists (SN: 2/5/72, p. 89). Their names were announced this week in Washington in ceremonies climaxing five days of activities planned for the students. It was the first time since 1942 that a girl had won first place—now a $10,000 scholarship; five of the ten finalists were females.

Tabachnik worked on the effects of automobile-exhaust pollution on plant life. Her paper was titled "The Effects of Aldehydes upon the Chlorophyll Content of *Euglena gracilis*." She found that from concentrations of 20,000 parts per million down to 210 parts per million, acetaldehyde and benzaldehyde proved lethal to *Euglena gracilis*. At 52 parts per million, acetaldehyde produced a 14.7 percent decrease in chlorophyll content per cell and benzaldehyde, a 64.7 percent decrease over a two and one-half hour period. (As of 1966, actual environmental levels of aldehydes sometimes reached 0.27 parts per million). Tabachnik hopes to do further research on sublethal effects of current atmospheric concentration levels.

Five of the ten finalists were from New York, including three from the Bronx High School of Science. Both $8,000 winners were mathematicians. Tony Giordano Horowitz of Long Island City, N.Y., studied mathematical linguistics. He created what he believes to be a workable algebraic model of the syntax of language. Susan Eva Landau, New York City, investigated the theory of "perfect numbers"—numbers that are one-half the sum of the numbers by which they can be divided.

Of the three $6,000 scholarships winners, two were from Memorial Senior High School in Houston. Donald Jeffrey Solomon did research in microbial genetics. He studied the effects of nalidixic acid on the genetic behavior of different strains of the bacterial species, *Escherichia coli.* Holly Hyde Birdsall, also of Houston, studied the modification pattern of the DNA in certain strains of bacteria. Alan Stuart Grenadir of Martin Van Buren High School, Queens Village, N.Y., did research in number theory. He attempted to extend the generality of a theorem known as the Möbius inversion formula.

Four students won $4,000 scholarships: Jonathan Gershenzon of Hollywood High School, Los Angeles; Dora Yuen-Kie Lee of the Bronx High School of Science; Walter Philip Schiefele of Northeast High School, Philadelphia; and Denise Margaret Canfield of East Leyden High School, Franklin Park, Ill. Gershenzon's paper entitled "Indicator Plants of the Hillside Chaparral Plant Association" differentiated and classified groups of plants that compose chaparral. Lee tried to prove that the classic problems of trisecting the angle and duplication of the cube are impossible to solve. Schiefele developed a machine that could recognize the numbers and arithmetic signs being