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

drawn by a person using a special pen attached to the machine. He also built a small digital computer that was linked to the machine. Canfield studied the effects of molten potassium chlorate on the tensile strength of soft glass.

Two alternates were named: James Laurence Michel of Portland, Ore., and David Albert Rudman of Bloomington, Ind. Each of the 30 semifinalists received $250 awards from Westinghouse Educational Foundation.

In explaining the rationale of the talent search, Edward G. Sherburne Jr., director of Science Service, said: "Doing independent research is a far better analogue of adult success than academic achievement." Science Service administers the talent search for Westinghouse under the direction of Dorothy Schriver.

David Axelrod, chairman of the board of judges, said of this year's 1,133 fully qualified entries: "The projects continue the trend toward less abstract work with more relevance to society. Even the students involved in mathematical research intend to end up in some field of social significance."

Seven hundred guests attended this year's announcement banquet. Lewis M. Branscomb, director of the National Bureau of Standards, was the keynote speaker. Robert L. Wells, vice president of Westinghouse, reminded the students of the real relevance of scientific research—relevance that becomes apparent only when the esoteric concepts are interpreted to the layman. He pointed out that Albert Einstein was able to make his highly difficult work understandable to the layman. □

Longitudinal waves from massive photons

The currently accepted theory of electrodynamics is based on the assumption that the photon, the light particle, has no rest mass. Theories can be built in which the photon does have a rest mass, and some physicists have looked for experimental effects of a massive photon (SN: 7/17/71, p. 46).

Now comes a Russian contribution to the massive-photon lore. In the Dec. 20 JETP LETTERS M. E. Gertsenshtein suggests that the experiments of Joseph Weber, which are believed to be recording gravity waves, could be recording a massive-photon effect. If his results are accepted as gravity waves, they raise serious cosmological difficulties (SN: 3/4/72, p. 149).

The construction of Weber's detectors is such, Gertsenshtein suggests, that they could be recording longitudinal electromagnetic waves. Massless photon electrodynamics allows only transverse electromagnetic waves, but a massive-photon theory could have longitudinal ones. □