metal plates, which act as electrodes. If there is any charge on the balls they will move from their equilibrium position toward the electrodes of opposite sign. At the beginning, the balls are bombarded with electrons and positrons, which bear unit charge, negative and positive respectively, to neutralize them. When this neutralization procedure is exhausted, the experiment measures any residual charge, which at this point would have to be in fractions of a unit.

Surprisingly, the experimenters find more and more balls, which, as far as they can tell, have charge in one-third of a unit. The latest count is nine of $+\frac{1}{3}$, five of $-\frac{1}{3}$, out of 39 balls tested. The others tested neutral. The figures are up from just one ball when the experimenters first started to talk on the record about the results of their work.

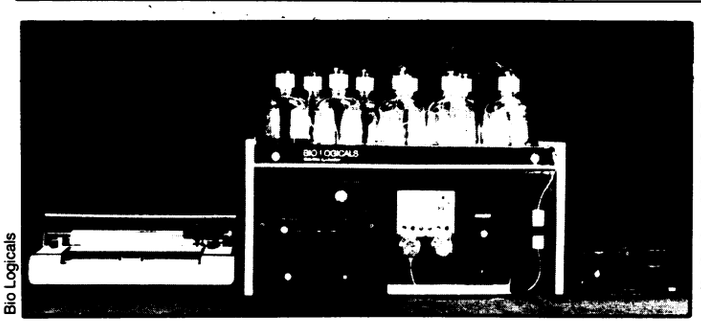
As Fairbank points out, this result would have gone over much better 15 years ago than it does today. At that time there was an expectation that charges of $\frac{1}{3}$ the electron charge might be observable in nature. The theorists of particle physics had just postulated the existence of the quarks, the basic constituents out of which most of the particles known to physics could be built. Quarks have to have charge in $\frac{1}{3}$ and $\frac{2}{3}$ amounts. People began to look for quarks experimentally. Failure to find free quarks in a number of experiments led theorists to think of good reasons why quarks must always be confined inside the structures they build and never exist as free particles. These reasons are now at the basis of the theory and must be defended for fear of the work that would have to be redone if this theory that explains so much should come apart.

Fairbank's audiences are perhaps smaller than years ago, but they are just as respectful and, if anything, more concerned. People are heard wishing this troublesome experiment would go away somewhere. □

## Space Telescope institute

A year ago, the National Aeronautics and Space Administration decided to establish a separate organization to run the activities of the earth-orbiting Space Telescope, expected to be carried aloft by the space shuttle in early 1985 (SN: 1/19/80, p. 39). Now the Association of Universities for Research in Astronomy (AURA) has been awarded a five-year, $24 million contract to organize and operate the Space Telescope Science Institute, with three five-year options to cover the instrument's anticipated 15-year lifetime. The institute, initially directed by University of Wisconsin astronomer Arthur D. Code, will be located at Johns Hopkins University's Baltimore, Md., campus, from which it will be linked to the telescope's control center at the nearby NASA Goddard Space Flight Center. □

## Gene machine: Automated DNA synthesis




Bio Logicals

*Gene machine automatically pumps chemicals through a column of particles that bind the growing chains. The operator need only specify the nucleic acid sequence.*

Linking the four building blocks of genetic material into synthetic sequences in the laboratory has been a skilled craft. An organic chemist working with several technicians spends months synthesizing step by carefully planned step a few micrograms of a simple gene segment. Now computerized systems for automatic DNA synthesis are about to turn that craft into an industry.

At a press conference Jan. 22 Bio Logicals, a small Toronto biotechnology firm, introduced a gene synthesizing machine that it will market for $19,500. At least three and possibly five companies will soon have computerized gene-synthesizing systems on the market, according to BIOENGINEERING NEWS, and together they are expected to sell up to 400 units per year. Bio Logicals president Robert Bender says, "The DNA/RNA synthesizer is just the beginning of a sophisticated new technology that will make genetic engineering a true industrial process."

The gene assembly area in the Bio Logicals machine is a column of solid particles. The gene components (nucleotide bases), and chemical reagents and solvents flow through the column. A computer directs openings and closings of valves between reservoir bottles and the solid support column. It takes the machine 45 minutes to add each nucleotide to the growing chain; the cycle has six steps that include chemically protecting and exposing appropriate parts of the chain.

Bender says that the machine has already been used to synthesize strings of 20 nucleotides, but the developers do not yet know the limit of the machine's capability.

There is already one "microprocessor-controlled polynucleotide synthesizer" marketed by Vega Biochemicals in Tucson, Ariz., but Bio Logicals claims that its new machine is faster, at half the price. "We have a new synthetic chemistry and have packaged it in such a way that the machine can be operated by a non-chemist," Bender told SCIENCE NEWS. "It is simple enough to be operated by any intelligent person with 30 minutes' training," he says.

The prospect of simply creating their own DNA sequences appeals to biologists. According to BIOENGINEEING NEWS other polynucleotides have been purchased for as much as $10,000 per microgram. The strings of nucleotides are most often used to locate a desired gene in a cell. A radioactively labeled DNA segment will bind to a corresponding sequence on a chromosome. The segments also can be linked together to form a totally synthetic gene. In the future, such segments may also be used as new regulatory regions to allow scientists to better control the activity of a gene in a cell. □

## New HHS rules for research on humans

The Department of Health and Human Services has released new rules concerning protection of human participants in scientific research. The rules appear in the Jan. 26, 1981 FEDERAL REGISTER and will go into effect on July 27, 1981. HHS estimates the rules will exempt 50 to 80 percent of all research projects subject to review, primarily in the social and behavioral areas. The department is the largest single source of research money in the United States, especially for medical and behavioral studies, and the rules apply to all of the research it funds.

The new rules represent an attempt to reduce the paperwork needed to review research that presents little or no risk. A first draft of the rules was published in August 1979, and more than 500 comments were received — many from social scientists and historians who feared the rules would require them to get permission from a review board before using information about persons mentioned in public documents.

As a condition for receiving federal funds, institutions must still set up local review panels called Institutional Review Boards to protect human subjects from undue risk or invasion of privacy by researchers, but the following five categories of study are now exempt from review board approval:

- educational research, especially for comparing different types of instruction,
- research on educational testing when subjects remain anonymous,
- research using only surveys or interviews, except when subjects can be identified,

• research involving observation of public behavior, which is also subject to privacy rights and
• research using existing data or documents when publicly available or when subjects cannot be identified.

In addition, research involving surveys of or interviews with elected or appointed public officials or candidates for public office will be exempted. And an "expedited review" will be established for low-risk medical research.

The strength of the new rules, according to Charles McCarthy of the National Institutes of Health, is that they no longer require review boards to examine nonfunded and low-risk behavioral projects. Many of these projects are done by students and professors on a small, nonfunded scale. □

# National Geographic focuses on energy

The energy crisis—its causes, its repercussions and attempts being made to cope with it—has been captured in a special bonus February issue of NATIONAL GEOGRAPHIC magazine. Carrying no advertising, the 118-page issue represents a year's efforts by the staff to assemble a colorful, panoramic primer outlining where wasteful consumption patterns are leading the world's energy consumers.

A 12-page atlas illustrates U.S. oil, coal, natural gas, geothermal, nuclear and solar energy resources in a splash of lucid maps, graphs and charts. Not only do they highlight the nation's resource potential in these critical areas, but also the attendant political and environmental problems expected to develop with their increased exploitation. Technical concepts are pictured in diagrams and photos accompanying articles packed with statistics. But in each case, authors focus on the human dimension of the energy picture, especially how "Yankee ingenuity" is being harnessed to develop practical solutions (such as burning walnut shells and installing a new breed of composting toilets) to the problem.

During their research, the magazine's editors found "conservation and increased efficiency offer the only reasonable immediate relief." New fuels, such as synthetic substitutes for crude oil, will probably play a major role in the future, but won't make their dominent impact until well into the late 1980s or 1990s. "We are looking at a once-in-a-lifetime phenomenon — the creation of a major new industry on the scale of the railroads and aerospace," explains an Exxon Co. vice president in his assessment of what's ahead for synfuels. And what about that American dream of self-sufficiency? "[It] will require more concerted effort than our entire moon program," concludes editor Wilbur Garrett. □

# The top 40 of the Science Talent Search

The U.S.S. Enterprise is locked in cosmic conflict with an enemy starship. Spock, Scotty and the gang are all there to assist in choosing a defensive command. Should the crew fire torpedoes or phasers? Should they try to evade the enemy? Suddenly, enemy fire damages the defensive shields of the Enterprise. The ship is now running low on energy so the crew must engage Automatic Helm Control and plot a course to one of the starbases.

Although it sounds like a "Star Trek" rerun, this galactic scenario is a situation that might be encountered playing STARSHIP, a complex computer game designed by high school student John Scott Penberthy of Midlothian, Va. While a number of Star Trek computer games exist, STARSHIP is more complex and just as rapid, allowing two to nine players to communicate with each other in an elaborate game of interstellar warfare and requiring only about three to six seconds to respond to commands. Such a program could have applications in science and business information systems.

Now Penberthy has the opportunity to bring this computer program to Washington: He is among the 40 chosen as winners in the 40th Annual Science Talent Search. On Feb. 26, the six female and 34 male high school students—judged tops among 993 completely qualified entrants—will begin a five-day Science Talent Institute session, which will include a display of their projects at the National Academy of Sciences. In addition, $89,500 in Westinghouse Science Scholarships and Awards will be presented.

The session features projects in scientific disciplines such as medicine, physics, engineering, biochemistry and astronomy. The math category, for example, includes six entrants this year. Entrant Tan Dinh Ngo probably best took advantage of the universal language of mathematics: Ngo is a Vietnamese refugee who has been living in New York less than two years. For his Science Talent Search project, he developed and tackled a mathematical problem similar to one posed by mathematician Paul Erdos nearly 40 years ago.

While some of the contestants spent their grueling hours of research at a desk, in a basement or at a hospital facility, the outdoors was one student's laboratory. Forrest Lincoln Piehl of Keyser, W. Va., selected his science project while hiking one day near his home. There he noticed fresh "blazes" — tree wounds caused by deer antlers. Piehl's project involved determining which species of trees most often fall prey to blazing. The results of this Science Talent Search project could improve deer management procedures to prevent timber loss.

The Science Talent Search, which is conducted by Science Service, is the oldest and largest high school science scholarship program in the United States. Past winners include four who went on to win Nobel Prizes—including 1949 Science Talent Search winner Walter Gilbert of Harvard University who shared the 1980 Nobel Prize in chemistry. This year's winners come from 37 schools in 14 states.

This year's 40 winners are:

ALABAMA: *William Shelton Chitwood,* Lawrence County H.S., Moulton.

CALIFORNIA: *Stephen Wong Lim,* Alhambra H.S., Alhambra; *Joan Inyul Chu,* Acalanes H.S., Lafayette; *Daniel Shenon Briggs,* Tamalpais Union H.S., Mill Valley; *William Ko,* San Marino H.S., San Marino.

CONNECTICUT: *Michael Morgan Dowling,* Newington H.S., Newington.

FLORIDA: *Eduardo Antonio Garcia,* Christopher Columbus H.S., Miami; *Song Tan,* Southwest Miami H.S., Miami; *Douglas Anthony Simons,* Vero Beach H.S., Vero Beach.

ILLINOIS: *Randall Todd Hayden,* Whitney M. Young H.S., Chicago; *Wendy Eileen Soll,* Evanston Twp. H.S., Evanston.

MARYLAND: *Jin-Moo Lee,* Friendly Sr. H.S., Oxon Hill.

NEBRASKA: *John Marion Geppert,* Creighton Preparatory School, Omaha.

NEW JERSEY: *Regina Lee Sohn,* Parsippany Hills H.S., Parsippany; *Ezekiel Michael Leventhal,* Waldwick H.S., Waldwick.

NEW YORK: *Mara Mae Gross,* Baldwin Sr. H.S., Baldwin; *Bruce David Binderow,* Benjamin N. Cardozo H.S., Bayside; *Michael Richard Candan,* Benjamin N. Cardozo H.S., Bayside; *Tan Dinh Ngo,* John F. Kennedy H.S., Bronx; *Marc Adam Turkel,* Riverdale Country School, Bronx; *Charles Curtiss Mancuso,* Nichols School, Buffalo; *Mark Lewis Movsesian,* Forest Hills H.S., Forest Hills; *Lori Ellen Kaplowitz,* George W. Hewlett H.S., Hewlett; *Michael Philip Lisanti,* Hillcrest H.S., Jamaica; *Martin Bruce Miller,* Jamaica H.S., Jamaica; *William I-Wei Chang,* Bronx H.S. of Science, New York; *Seth Steven Finkelstein,* Bronx H.S. of Science, New York; *Daniel Y. D. Yu,* Bronx H.S. of Science, New York; *Terence David Sanger,* The Dalton School, New York; *Amy Sue Reichel,* Hunter College H.S., New York; *Joel Martin Wein,* Stuyvesant H.S., New York; *Thomas Orren Patterson,* Roy C. Ketcham H.S., Wappingers Falls.

TEXAS: *Jeffrey Roser Smith,* Skyline H.S., Dallas; *Edward George,* Coronado H.S., El Paso; *Garrett Trent Biehle,* Westchester Sr. H.S., Houston.

VIRGINIA: *John Scott Penberthy,* Midlothian H.S., Midlothian; *Michael Frank Reidy,* West Springfield H.S., Springfield.

WASHINGTON: *Bryan Douglas Henderson,* Timberline H.S., Lacey.

WEST VIRGINIA: *Forrest Lincoln Piehl,* Keyser H.S., Keyser.

WISCONSIN: *Jonathan Eric Fliegel,* James Madison Memorial H.S., Madison. □