Education

National laboratories expand pre-college education programs

Largely because of the attention given in recent years to the sorry state of pre-college science education in the United States, the national laboratories funded by the Department of Energy have expanded their educational programs, providing models for other labs and industrial research organizations.

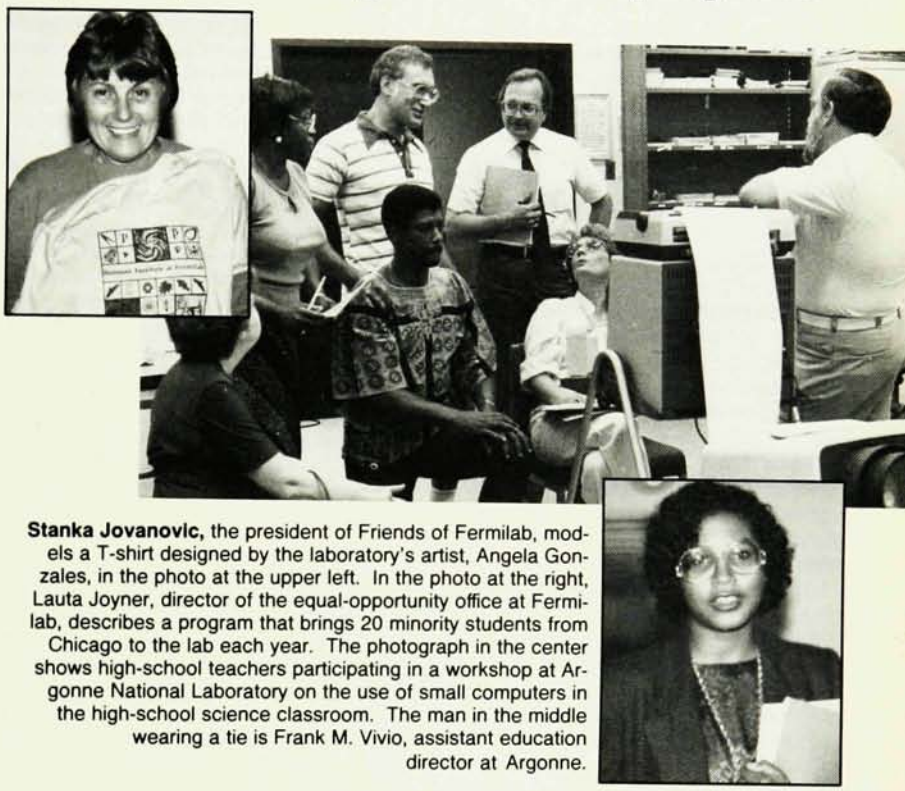
In September 1984 Argonne National Laboratory hosted a conference on the role that the national labs can play in pre-college education, and the proceedings were published last year. Meanwhile, DOE education specialist John Ortman has prepared a similar but more concise document on educational programs at laboratories funded by the Energy Department.

The Argonne proceedings and the DOE report provide an overview of what the major labs have been doing. A visit to the Midwest last December provided an occasion to become more closely acquainted with the programs at one lab—Fermilab—that has organized and found funding for its programs in unusually imaginative ways.

Looked at in a national perspective, it is apparent that each of the laboratories has approached pre-college education with a somewhat different philosophy. At Argonne, according to assistant education director Frank M. Vivio, they have concentrated on introducing the most highly gifted students they can find to the kinds of research sponsored by DOE. Argonne also has tried to provide teachers with practical advice and to bring them up to date on the latest advances in science.

Argonne. Since summer 1984 Argonne has cooperated with Northwestern University in a program called the Midwest Talent Search. Last year the Talent Search brought nearly a hundred junior-high students from the Chicago area to the lab for a three-week, non-residential program.

Since 1980 Argonne has brought area high-school sophomores to the laboratory daily for five or six weeks during the summer to give them some direct exposure to science or engineering research at the lab. Originally for minority students, this program was opened to all area sophomores in 1982.



Stanka Jovanovic, the president of Friends of Fermilab, models a T-shirt designed by the laboratory's artist, Angela Gonzales, in the photo at the upper left. In the photo at the right, Lauta Joyner, director of the equal-opportunity office at Fermilab, describes a program that brings 20 minority students from Chicago to the lab each year. The photograph in the center shows high-school teachers participating in a workshop at Argonne National Laboratory on the use of small computers in the high-school science classroom. The man in the middle wearing a tie is Frank M. Vivio, assistant education director at Argonne.

Another pre-college program brings 50 or 60 high-school seniors to Argonne each summer for eight weeks to work with a scientist or group of scientists on research projects, which the students are required to write up at the end of the summer.

High-school teachers are brought to Argonne each summer and are assigned to a scientist to work on a research project. Each teacher receives a stipend of around $400 per week. Last summer, thirteen teachers from Chicago public schools participated, along with seven from suburban schools and one from California.

A national project to place high-school teachers at Argonne, Brookhaven and Lawrence Berkeley Laboratories came directly out of Argonne's 1984 conference on the labs and pre-college education. Last summer there were quite a few nominations, Vivio reports, and six teachers were placed.

Los Alamos and LBL. At Los Alamos National Laboratory, which is more isolated than Argonne, the emphasis has been on community outreach in the seven northern counties of New Mexico. The lab sends a staff member out to elementary schools to do "gee whiz" demonstrations for pupils in grades 4–6; a Monday morning program brings grade-school children to the Bradbury Science Museum, which has been expanded and improved in recent years; a panel of minority staff members from the lab goes out to give talks at schools to encourage minority students to study science; there are after-school courses twice a week for high-school juniors and seniors that attract students from as far away as Taos; and "science youth days" bring students from all over the Southwest to the lab for a day each year.

Los Alamos conducts a four-week, non-residential summer institute for

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science teachers, and in 1986 the topic will be physics. Participants, who sometimes live with friends or relatives during the workshop, receive "collaborator's fees" and can get credit.

Another kind of teacher workshop, which teachers have helped to design, is being developed at Lawrence Berkeley Laboratory in California. In 1983 Lawrence Berkeley launched a program for Bay Area high-school teachers in which they spent half their time for six weeks associated with research projects. The rest of the time they met as a panel to define goals for future summer programs and make recommendations about how such programs should be designed. In 1984 Lawrence Berkeley expanded the program to involve 11 teachers, each of whom received a $1500 stipend; in 1985 the program took 20 teachers. The 1984 program was coordinated by graduates of the 1983 program and in 1985 the program again drew on previous graduates for direction.

Elementary education at LLNL. Probably the most successful educational project at another major Bay Area laboratory, Lawrence Livermore, has been LESSON, a curriculum for science instruction in grades K–8 that consists of 43 lesson manuals and four demonstration kits. The course was developed at Lawrence Livermore in 1969 and was given to thousands of pupils during the following years by lab personnel. In 1975 the program was converted into a summer workshop to train teachers in the use of LESSON.

Teachers also have been trained to use LESSON in workshops at the University of New Mexico, Northern Arizona University and Jackson State. The LESSON curriculum was used and evaluated by a group of teachers in about 45 schools in northern Alabama in 1984–85. The effort was funded by Livermore and coordinated by Saundra McGuire of the Alabama A&M chemistry department. Reviews have been quite favorable, McGuire says. One teacher wrote that in her classroom "science has changed from the stepchild to the belle of the ball" as a result of LESSON.

Another Livermore program for elementary-school children, HELP, has sent laboratory staff to hundreds of Bay Area schools to do four classroom presentations in consecutive weeks. Lawrence Livermore also provides tutors for pupils and students, lends used equipment to schools and sends staff to do demonstrations in elementary schools. "Crucial decisions often are made earlier than high school," Manuel Perry of Livermore observes, "and as a consequence many Livermore precollege programs have been directed at elementary- and middle-school students."

Illinois appropriates money for science academy

The Illinois Legislature voted last fall to establish a state science academy and appropriated $500 000 in planning money for the school. The initiative to establish such an academy originally came from Leon Lederman, director of Fermilab. Around 40 individuals representing teachers, education administrators and experts, laboratories, local industries and school boards have been involved in designing and promoting the academy for several years. Walter Massey, vice-president of the University of Chicago and former director of Argonne National Laboratory, has also been among the active planners.

The bill establishing the academy calls for it to open in the fall of 1987, though Lederman would like to see it start up a year earlier, if possible. The academy is to be located in a school building in Aurora that was built in 1977 and closed down only four years later because of declining enrollments. The building contains ample laboratory space, and architects are at work on designs for dormitories.

The Illinois Science Academy is to be residential, a somewhat quaint feature in this day and age, perhaps, but Lederman points out that there is no other way of creating an elite, magnet institution for all residents of Illinois. Lederman, a native of New York City, wants gifted children in Illinois to have the same kind of educational opportunities found at New York City schools such as the Bronx High School of Science and Stuyvesant High School.

The academy will stress science and mathematics, but it will be a liberal-arts institution, providing advanced offerings in history and English, foreign languages and all the rest. The academy will cover grades 10–12 on an accelerated basis, so that many students will leapfrog the freshman year in college and enter as sophomores. "The idea," Lederman says, "is to eliminate senior slump and freshman malaise."

The academy is to open with roughly 200 students but eventually is to accommodate about 800 in the three classes at any one time. In Lederman's estimation, an appropriation of $6–$7 million will be needed to get it started.

The only other state residential science academy was established by the North Carolina General Assembly in 1978. It opened as a two-year school for juniors and seniors in September 1980 and now has about 400 students. It is located in a former hospital near the Research Triangle in Durham.

F. Borden Mace, the former principal of the North Carolina School of Science and Mathematics, has been named interim director of the Illinois academy. Joe Meyer, a teacher at Oak Park and River Forest High School in Oak Park, Illinois, has been hired full time to assist Mace. Meyer is chairman of the AIP Educational Policy Committee and was president of AAPT in 1984–85. —ws

SLAC and BNL. At the Stanford Linear Accelerator Center, the focus has tended to be on minority and economically disadvantaged students. SLAC provides work after school and during breaks and summers for six or seven students who are interested in science and need financial assistance. The Youth Opportunity Project gives summer work in a variety of laboratory settings to about 15 students, and the Summer Science Program selects 20 graduating high-school seniors or college students to work and study at the lab for nine weeks each summer. The laboratory also hires about 50 college and graduate students for regular jobs each summer.

Across the country, Brookhaven National Laboratory participates in the Long Island Forum for Technology, an unusual program that provides awards to outstanding high-school students and teachers on Long Island. Each year the lab sponsors an "Awards and Recognition Day," when selected students and teachers receive cash awards and plaques. Laboratory scientists do the presentations, and what impresses the recipients the most, according to Donald J. Metz of Brookhaven, is "the number of important people who give up their Saturday morning to come to the ceremony and say a few words of praise."

Brookhaven scientists have offered special courses for high-school teachers since 1970, when a member of the staff got involved with the PSSC curriculum project. Offerings in the 1970s and 1980s have included courses on energy and on radiation health. (Argonne gave a similar course last summer on risk assessment.)

Since 1970 Brookhaven has employed teachers on its tandem Van de Graaff accelerator. Brookhaven adopted the idea from Los Alamos, Metz explained at the Argonne conference, when administrators and scientists asked where they could find people "who are available for shift work, nights and weekends, and to fill in summers for staff members on vacation, and who also have fairly high learning curves."

Low pay and social status are the afflictions of the high-school teacher's life most places in the United States. In the western suburbs of Chicago, national laboratories have joined with a group of industrial research laboratories in the Corridor Project, named after a high-tech strip along the East–West Tollway west of Chicago. The Corridor Project was launched at the suggestion of Fermilab and it provides summer employment for local high-

school teachers at the various facilities. The program involved 26 teachers each summer in 1984 and 1985; teachers usually received a salary of $400–$500 per week, which is competitive with what they earn during the school year. Participating institutions include Amoco Research Center, AT&T Bell Labs, Nalco Chemical Company, Northern Illinois Gas, Argonne and Fermilab.

Fermilab. Like Argonne, Fermilab has been involved in education for many years, and some of its projects already are well known to physicists around the country. Fermilab searches nationwide, for example, for 20 minority graduate students to work at the laboratory each summer. Saturday Morning Physics, which consists of three annual ten-week courses involving lectures, small discussion groups and tours of the lab, now is in its sixth year and so far has graduated over 1500 high-school students (see PHYSICS TODAY, September 1982, page 11).

Fermilab's educational programs took a new turn in March 1983, when Friends of Fermilab was incorporated. Friends of Fermilab is a voluntary organization that conceives new educational projects for the lab, finds private and public support for them and, finally, coordinates them. The most active individuals in getting Friends of Fermilab off the ground and flying have been Stanka Jovanovic, an Argonne scientist, and Marjorie G. Bardeen, a teacher and former president of the Glenbard board of education in Glenellyn, Illinois.

Friends of Fermilab's flagship project has been a summer institute for 45 science teachers, which first was given in 1983. Each summer for the last three years the four-week program has taken 15 physics, 15 chemistry and 15 biology teachers, who spend Mondays, Wednesdays and Fridays in specialized classes and labs, and Tuesdays and Thursdays in plenary sessions. Labs are conducted afternoons at a local high school because it is considered essential to do them in a realistic setting. Participants are required to present laboratory demonstrations that they have found effective in classes. The 15 best demonstrations from the 1983–85 sessions currently are being printed for distribution, initially to the participants and later perhaps more widely.

Teachers selected for the summer sessions receive a stipend of $1000 and three graduate credits from Northern Illinois University. Unlike some similar training programs for teachers in other parts of the country, the institutes are intended to be useful, intelligible and interesting both to very highly qualified teachers and to the more "marginal" teachers—those, for example, who were accredited in other science fields and now are being required to teach physics.

The physics and chemistry training programs have had a promising spinoff in the creation of ongoing networks by participants in the 1983–85 workshops. Physics West and Chemistry West are meant to provide an opportunity for teachers in Chicago's suburbs to meet regularly and exchange ideas about innovative teaching methods. They are modeled on the Illinois State Physics Project, a network in Chicago proper that was started in the late 1960s with support from the National Science Foundation. When NSF funding dried up, the network kept right on going. The inspirational figure in the Chicago network for some years has been Earl Zwicker of the Illinois Institute of Technology, who has contributed to the Fermilab workshops and served as a friendly consultant to those organizing the suburban networks.

Zwicker, the winner of AAPT's 1984 Millikan Award, is well known for his imaginative demonstrations, which challenge the student's perceptual faculties as well as analytic and interpretive skills. "Start with the phenomenon" is Zwicker's rule of thumb, but those who have seen him at work might add, "*See* the phenomenon."

Finding funds. The 1983 and 1984 teacher-training institutes were supported by grants from the Bersted Foundation, the Forest Fund, the Furnas Foundation, the Grainger Foundation, the Chauncey and Marion Deering McCormick Foundation, the Robert R. McCormick Charitable Trust, Abbott Laboratories and DOE. Last year Friends of Fermilab received a grant of $255 000 from NSF to cover most institute expenses for three more summers, 1985–87. Bardeen, vice-president of the group, has coordinated the institutes, while Jovanovic, the group's president, has been instrumental in preparing grant proposals and raising money.

Last year, when Fermilab's minority internship program lost its DOE funding, Friends of Fermilab stepped into the breach and found independent support. The Target Science and Engineering Students program was founded in 1980 and since then has brought 20 minority high-school students from the Chicago area to the lab for six weeks each summer. Mornings are spent with supervisors doing technical jobs, afternoons in classes and on projects of the student's choice. The toughest thing about running the program is finding suitable jobs in radiation-free areas, reports Lauta Joyner, director of Target and equal-opportunity manager at Fermilab.

Each of the Chicago schools with substantial numbers of minority students is asked to nominate three students for the program each year, which makes the selection process very competitive. "These are all exceptional students," says Joyner. "Some of them are already doing college-level work."

The other major project currently being promoted by Friends of Fermilab is a curriculum kit for junior-high students called "Beauty and charm." David Boulanger, an administrator and science educator at Triton College in Illinois, has coordinated this project. Larry Small, a local educator and experienced designer of science education kits, did much of the curriculum development.

The kit is meant to provide students with analogies to the experiments and methods used in particle physics. The first unit introduces students to orders of magnitude and requires them to measure the smallest object they can find in the classroom. In the second unit, students are given instruments including scales, compasses, magnets, rulers or whatever measuring and detecting devices seem appropriate and sealed boxes containing unknown objects. A list of objects that might be in the boxes is put on the blackboard and student groups evaluate hypotheses about what the contents might actually be.

In the next unit, magnets are affixed to the insides of the covers of the boxes, and students investigate the deflection of steel balls rolling across the covers. In the third unit, balls are rolled down the ramp over a carbon-paper grid. From the tracks made by colliding balls, students are required to infer the heights of the ramps, the sizes of the

Teaching modern physics

On 24–27 April, a conference on teaching modern physics will take place at Fermilab. About 100 physics teachers will participate, half from high schools, half from colleges and universities. The objective of the conference organizers is to promote the teaching of particle physics and cosmology in high-school and introductory college courses. Leading research physicists will make presentations in plenary sessions, and lecturers and teachers meeting in working groups will draft teaching materials. Materials will be produced and tested following the meeting, and follow-up sessions will take place at the joint AAPT–APS meeting in San Francisco next winter. High-school teachers are eligible to receive support to attend both this year's and next year's meeting from a grant awarded to AAPT by NSF. The sponsors of the Fermilab conference include AAPT, Fermilab and Friends of Fermilab, with cooperation from the International Commission on Physics Education of the International Union of Pure and Applied Physics.

balls and so on. The tracks are analogous to trails in a cloud chamber, and the next unit introduces students to actual cloud chambers. Finally there is a tour of the laboratory facility.

The kit is currently being tested in classrooms by teachers trained at Fermilab last fall. When it has been revised in light of evaluation results, it will be made available nationwide.

Friends of Fermilab has found funding to make videotapes of Saturday Morning Physics, which have now been deposited at nine Chicago-area libraries. This April the group will cosponsor an international conference at Fermilab on teaching modern physics (see box on page 105).

When physics educators arrive at Fermilab next summer—especially those from the East Coast and from Europe—they are likely to be struck right off by the strong sense of community one finds in the Middle West and the absence of stuffiness even among people of the highest intellectual attainments. These are the midwestern qualities that almost always strike a visitor first, and these qualities no doubt have been mighty assets in the effort to break down the barriers that traditionally have divided research and academic scientists, high-school and junior-high-school teachers, and students and pupils.

—WILLIAM SWEET

AIP Executive Director Koch will retire in 1987

H. William Koch, Executive Director of the American Institute of Physics, has announced his decision to retire, effective March 1987. Koch informed Norman F. Ramsey, chairman of the AIP Governing Board, of his decision in a letter in February.

Koch has served as AIP's chief executive officer for 19 years. During his tenure AIP grew from a staff of 125 based in one New York City location to a staff of about 475 in four locations: two in New York City, a main publishing facility in Woodbury, Long Island, and an office in Washington, D.C. AIP created the Society of Physics Students out of Sigma Pi Sigma and its own student section program, expanded its manpower statistics and history divisions, greatly increased the number of translation journals it publishes, initiated a series of conference proceedings and—most recently—established a books division.

The number of pages published annually by AIP nearly doubled, from 70 000 in 1966 to 135 000 in 1985. The Institute has adopted the most advanced electronic techniques in publishing and has started to provide a variety of on-line electronic information services. It has expanded its involvement in international scientific communications and has entered agreements in recent years with organizations in West Germany, the Soviet Union, Japan and the People's Republic of China.

AIP represents a growing number of member societies, and when Koch retires it will be serving nearly twice as many individuals, counting SPS members, as when he joined the staff as Executive Director in 1966.

CECELIA BRESCIA

KOCH

Koch was born in New York City in 1920. He received a BS in physics from Queens College in 1941, an MS from the University of Illinois in 1942 and a PhD from the University of Illinois in 1944. He worked at Illinois from 1944 to 1949 on betatron experiments. A 4.5-MeV betatron that he constructed and delivered to England in 1944 was subsequently converted by others into the world's first high-energy electron synchrotron. From 1949 to 1966 Koch worked as a research physicist in nuclear and high-energy x-ray physics at the National Bureau of Standards. While he was there, Koch's group developed the world's first large-aperture 180-MeV circulator accelerator for synchrotron-light research and a high-power 100-MeV electron linear accelerator. He was chief of the Radiation

Search initiated for AIP Director

The Executive Committee of the American Institute of Physics, acting on behalf of the Governing Board, has authorized a search for an individual to replace H. William Koch upon his retirement next year as Executive Director of AIP.

The chairman of the search committee is William W. Havens Jr, Executive Secretary of The American Physical Society, and the other members are Hans Frauenfelder (University of Illinois), Anthony P. French (MIT), Karl G. Kessler (National Bureau of Standards), Edward N. Sickafus (Ford Motor Company), Harold F. Weaver (University of California, Berkeley) and Roderick M. Grant (AIP Secretary, ex officio).

The Executive Director of AIP is appointed by the Governing Board and serves as AIP's chief executive officer. The Governing Board seeks a physicist with demonstrated ability in research and administration. The Executive Director administers the Institute in accordance with instructions from the Governing Board and is expected to provide imaginative leadership in maintaining AIP's services in scientific publishing, meeting the needs of its member societies and guiding its programs in education and public affairs.

Nominations for the Executive Director position should be sent to W. W. Havens Jr, Chairman, Search Committee, AIP, 335 East 45th Street, New York, NY 10017. Self-nominations are encouraged. The deadline for receipt of all nominations is 1 May 1986.