AIP CORPORATE ASSOCIATES MEET AT HEWLETT-PACKARD'S PALO ALTO LAB

Physicists increasingly rely on computers in their research and communications, and computer technology in turn relies heavily on advances in physics. This synergistic relationship was explicitly recognized in the theme for the annual meeting of the Corporate Associates of the American Institute of Physics: physics in the information age. Appropriately enough the meeting, held 19–20 October, was hosted by Hewlett-Packard Laboratories in Palo Alto, California. The Corporate Associates are corporations and organizations who join the institute in its goals of improving communication among physicists in industry, universities and government.

William Hewlett and David Packard developed their first commercial product—an audio oscillator—in a legendary garage that has now been designated by the state of California as the "birthplace of Silicon Valley." Since this humble beginning in 1939 Hewlett-Packard has grown into a $16.4-billion company that spends about 10% of its net revenue on R&D. Approximately 8% of the R&D money is allocated to Hewlett-Packard Laboratories, the company's central research facility in Palo Alto, with branches in the UK and Japan.

Hewlett was on hand to welcome the corporate associates. His mind was very much on the next generation as he encouraged efforts to improve science education. Echoing his concern was a talk by Mary Budd Rowe (Stanford University) during the second day that dealt with new programs in precollege science education and the role that industry can play.

Social gatherings and seminars gave participants a chance to learn about the latest physics at the AIP Corporate Associates meeting. Left: Terry Cole of JPL (left) chats with Benjamin Snavely of NSF over lunch. Snavely heads AIP's advisory committee on Corporate Associates. Below left: Will Happer of DOE discusses science funding. Below right: Horst Stormer of Bell Labs speaks about electron optics. (All photos by Cecelia Brescia.)

The information age

Among the contributions that physics research has made to the computer industry is the development of precision clocks. Leonard Cutler of Hewlett-Packard traced this development from timepieces based on Earth's rotation through the current cesium standard to such future possibilities as clocks based on single-ion devices. Other research has been directed to computing algorithms. Joseph Fisher of Hewlett-Packard discussed instruction-level parallel processing, outlining strategies for increasing the number of operations that can be done in each cycle. He said that one could add more hardware to compute all branches at once, but that it's preferable where possible to perform calculations ahead of time along the most likely branches; the latter procedure is called "speculative execution."

The needs of physics have in some cases driven the development of computing systems. Norman Christ of Columbia University described quantum chromodynamics calculations that require such massively parallel computing power that researchers have designed their own machines. A group at Columbia has built a 16-gigaflop computer and is participating in a consortium with MIT, Lincoln Labs and Thinking Machines to develop a machine with a peak capacity of 2.6 teraflops that should be operational by 1995.

Astronomy also requires large computing power. Harold McAlister of Georgia State University reviewed the use of optical interferometry to gain high angular resolution. He described plans of the Center for High-Angular-Resolution Astronomy to build an array of optical telescopes having a resolution of 15 microarcseconds. The facility will be built in New Mexico by Georgia State and

Georgia Tech.

Other talks at the meeting dealt with policy issues. Funding is a big issue in the US, of course, and one that has daily beset William Happer, director of the office of energy research at the Department of Energy. Happer spoke about some of the tough choices that have to be made about various items in the science budget. Happer feels that pork-barrel projects seriously hurt the department's efforts to put money into the best projects, and so does a perception on the part of some members of Congress that scientists have been given carte blanche for too long.

But the problems of science in the US don't approach those in the former Soviet Union. Roald Sagdeev of the University of Maryland, College Park, and the Space Research Institute in Moscow described the tremendous economic upheaval in Russia and its impact on scientists and engineers. About half of the world's engineers are in the FSU, so the magnitude of the problem, he remarked, is comparable to finding new employment for all the lawyers in the US. Sagdeev acknowledged that science will have to shrink in the FSU but asserted that the best work should be supported.

Frontiers of physics

Four talks dealt with physics frontiers. Emmanuel Desurvire (Columbia) spoke about erbium-doped fiber amplifiers and their impact on lightwave communications. These amplifiers, which are pumped by laser diode chips, will replace electronic repeaters on transoceanic fiber optic routes by 1995. The erbium amplifiers have a bandwidth in the terahertz range and enable the transmission of signals at rates of tens of gigabits per second across the ocean. Soliton transmission may soon follow.

Horst Stormer (AT&T Bell Labs) spoke about developments in two-dimensional electron systems. Modulation doping has so greatly increased the mobilities of electrons that they can now travel 100 microns without colliding. These essentially ballistic electrons lend themselves to electron optics; they can be refracted or focused by an electronic lens. Two-dimensional electron systems also exhibit the quantum Hall effect: Experimenters have found lots of cases in which the quantum number is a rational fraction with an odd denominator, but more recently they have also seen various even-denominator quantum numbers.

Moving from small spatial dimensions to large energy dimensions, Alan Guth (MIT) spoke about the birth of the cosmos. He described the success of the standard theory of the hot Big Bang and the modifications that were required to account for the general uniformity of the cosmic background radiation, the observed nonuniformities and the proximity of the mass density to the critical density separating a universe that recontracts and one that expands indefinitely. The picture of the inflationary universe proposed by Guth, by Andrei D. Linde and by Paul Steinhardt and Andreas Albrecht offered an explanation for these features.

In contrast to the electron optics discussed by Stormer, David Pritchard (MIT) spoke about atom optics. In reciting the analogies of photons to atoms, Pritchard said that electromagnetic fields or zone plates can be used as lenses, crystals or evanescent waves as mirrors, and standing light waves as gratings. However, said Pritchard, working with de Broglie waves requires a lot more money and considerably more finesse than dealing with light waves.

Tours of the laboratories

The 600 scientists who work at Hewlett–Packard Laboratories occupy two buildings in Palo Alto as well as a corporate laboratory in Bristol, England, and a smaller lab in Tokyo. These are multipurpose labs, but their work is generally focused on Hewlett–Packard's main product areas—computers and measuring instruments. Participants at the meeting were offered two tours, each corresponding to one of these two areas of research. At the computer research center, located on Page Mill Road, participants saw demonstrations of such information-related technology as magnetoresistive recording heads, thermal ink jet technology and helical tape storage. The demonstrations included a physician's workstation and a robot used in manufacturing.

The second tour group went to the measurement research center, situated at the laboratory's other Palo Alto facility on Deer Creek Road. The visitors learned about Hewlett–Packard's work on optoelectronic devices and saw the molecular beam epitaxy facility for growing III–V compounds. The tour covered a variety of topics from capillary electrophoresis to a cesium clock to a high-Q superconducting resonator.

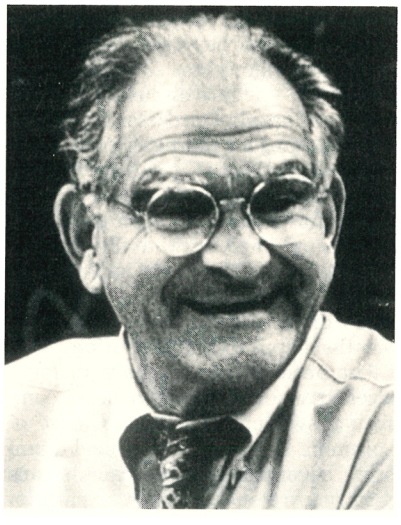
—Barbara Goss Levi

WEISSKOPF, SAGDEEV AND CASSIDY HONORED WITH AIP AWARDS

A highlight of the 1992 Corporate Associates Meeting was the presentation of three awards during ceremonies at the Holiday Inn in Palo Alto, California, on 17 and 19 October. Victor Weisskopf received the Compton Award, Roald Z. Sagdeev received the John T. Tate International Award for distinguished service to the profession of physics, and David C. Cassidy was given the AIP Science Writing Prize to a Scientist.

The certificate presented to Weisskopf with the award cited "his leadership throughout the world in advancing science, in promoting peace and in

Victor Weisskopf



Roald Z. Sagdeev