says Phillips. Opportunities for foreign architectural and engineering firms and equipment vendors likely will be limited to the first four of ten 1000-megawatt units the Chinese plan to erect by 2000. China hopes to build most components domestically by the mid-1990's.—MARK CRAWFORD

Universities Urged to Enter the Information Age

Picture a university math building. To many, it conjurs up images of a drab, fluorescent-lit room full of cramped desks. Equations are scrawled across a dusty chalkboard and students with pocket calculators strain to comprehend complex, abstract concepts in black and white.

This is the math lab of the past, but unfortunately it persists in too many colleges and universities. And these surroundings are part of what is causing gifted students and teachers to flee academia for better equipped workplaces in industry, says John H. Hubbard, a professor of mathematics at Cornell University.

The information age, says Hubbard in testimony presented to the House Science and Technology Committee's task force on science policy in hearings held 10 to 12 September, requires that the computer be brought into the math lab in a mass way. Today's manufacturing technologies, notes Hubbard, demand that students know how to employ differential equations to model and design components on computers. Such calculations are tedious, if not impossible, to do manually without computers.

Despite the widespread use of microcomputers, they have not found their way into nearly enough math departments in meaningful numbers, says Hubbard. Where computers have been introduced in a significant way, he adds, new life has been breathed into math curricula. Not only are students and faculty freed to explore theoretical and applied mathematical problems, but computer-driven color graphics aid comprehension and analysis immensely.

Hubbard recommends that every mathematics department be equipped with machines equivalent to a VAX or an IBM 4341 with terminals located in every faculty office. Minicomputers of the Apple or IBM PC variety are needed for every 15 students, he adds. Not only will more federal and state funds be needed to achieve this, but math buildings that typically get little attention will require expansion to accommodate the space-consuming equipment.

This sketch of math departments being surpassed by the information age is but one aspect of the mushrooming phenomena, which the House Science and Technology Committee is trying to come to grips with. Just as math departments have to scrap chalkboards for computers, computer science itself must look beyond its traditional information processing and computational structures, says John Seely Brown, director of Xerox's Intelligent Systems Laboratories. And universities must be fitted with state of the art equipment to avoid early obsolescence. Nevertheless, equipment life cycles may be shorter than traditional depreciation schedules, Brown notes.

Better software is needed, says Brown, to transform complex computations into data that can be easily comprehended. Furthermore, conceptual theories must be developed on how to search and filter information to allow management of content, rather than bulk information. With computing power expanding at a rapid pace, new computer architectures must be pursued. These should be less bulky to use, allow for faster problem solving, and permit new approaches to information management and computation.

David A. Pensak, a research supervisor with E. I. du Pont de Nemours' central research and development department, echoes Brown's observations. Interactive computing and graphics help researchers understand multidimensional molecular structures, but computer graphics need to be developed further, he says, to depict greather amounts of data and to do it in a three-dimensional way.

To make use of the coming advances in research and computer science, federal funding for basic research in methodology needs to be increased. Finally, Pensak says there should be stronger ties between universities and industry and better access to federal data banks.

—MARK CRAWFORD

Ignition Error Blamed for Ariane Failure

Paris. Arianespace, the company responsible for commercial launches of the European rocket Ariane, has announced that some form of ignition malfunction appears to have been the cause of the rocket's failure last week, leading to the loss of two telecommunications satellites.

The company also announced that it is setting up an investigatory committee to discover the precise cause of the failure of the third stage of the rocket to ignite properly, resulting in the decision of flight engineers to blow up both the rocket and its payload 10 minutes after lift-off.

It was uncertain whether the problem had been in the rocket's ignition equipment itself, or whether it was due to a blockage in the fuel supply. A statement issued by the company said that, although the valves feeding the fuel to the rocket motor had functioned correctly, an "abnormal ignition" took place in the combustion chamber 0.4 seconds late and that "since the nominal functioning conditions were not reached, the motor stopped functioning."

Arianespace officials in Paris point out that, despite the failure, Ariane still enjoys a good launch record, having previously achieved nine successful missions in a row. The most recent of these was the European Space Agency's Giotto spacecraft, which is due to rendezvous with the comet Halley next year.

However, the failure is expected to result both in delays to future launches—Ariane's order book is already full for the next 2 years—and to further increases in insurance premiums for satellites, which have already experienced significant rises in recent months due to problems with launches from the U.S. space shuttle.

The failure was also an embarrassment for the French government, which has paid 60 per cent of the development costs of Ariane, since the launch was being attended by President François Mitterrand, who had hoped to use it both as a symbol of French achievement in high technology and to reinforce his commitment to an independent European presence in space.—DAVID DICKSON