search and cancer prevention. It is increasingly popular to talk about cancer as an environmental problem, and NCI has been roundly criticized for not pumping more money in this direction. Some see in environmental carcinogenesis research the answer to many, indeed most, questions about cancer. Others see it as a fad and worry that NCI may go overboard in response to environmental hype.

Upton does not seem to be a man likely to go overboard, however. Former colleagues at Oak Ridge recall that the kinds of experiments he did required long-term observations of hundreds of animals and great commitment and patience; it was not the kind of work that led to a paper a month. "If anyone really has the experience to understand environmental carcinogenesis—and not many people do—it is Art Upton," one of his admirers said.

Upton, for his part, sees public awareness of environmental factors in cancer in historical perspective. "There has been a remarkable change of attitude in the past decade," he remarked, noting that when he began his own research career "there was great doubt that there was a relationship between cancer and exposure to small doses of radiation or that one could make linear extrapolations downward from what we knew about one-time exposure to massive doses. Now, we're beginning to understand—about radiation, about chemicals, about smoking. It is revolutionary. But I also believe that genetics plays an important part in the development of many cancers. We can't write it all off on the environment."

If one were going to put new emphasis on certain areas of research, what would it be? "We need a lot more good epidemiology," Upton observed. "It can tell us not only about environmental factors but also about genetic influences and we really do need to know about both." Another area in need of special attention is screening of suspected carcinogens. Even though there has been progress recently, science has a long way to go to achieve the kind of accurate, fast testing people would like—what Upton idealizes as a "tumor in a test tube within 48 hours." Citing just one of the current limitations, he says, "We think there is a better than 90 percent correlation between mutagenicity, which we can detect fairly easily, and carcinogenicity. But 90 percent isn't good enough, especially when we *know* that some cancer-causing hormones such as DES [diethylstilbestrol] aren't mutagenic in tests we have."

One environmental issue that is bound to raise substantial controversy is whether NCI should assume responsibility for testing the hundreds of chemicals that have to be screened under the Toxic Substances Control Act. Sentiment within NCI is sharply divided, the environmental scientists, whose numbers would grow were NCI to take on testing, being more or less for it, the rest being distinctly opposed. "NCI will be destroyed if it becomes a testing and regulatory agency" is a common forecast. On this issue, Upton seems to be of two minds. "I have no doubt that it is NCI's responsibility to do *research* on testing," he says, "but I don't know about the testing itself. Certainly I'd be against it if it would eat up our budget, and I suppose it could. But my gut feeling is that we have a duty to involve ourselves in this."

Upton's interest in environmental carcinogenesis should not be construed as evidence of lack of support for other areas of research—particularly not viral research, which has in the past several years consumed considerable amounts of NCI's money and attention. He sees viral oncology as a problem of genetics, of "understanding the information in viral genes, not trying to get a whole virus out of a tumor," and expects "great headway in the next decade."

In fiscal terms, the next decade—or at least the start of it—is likely to be a more modest one for NCI. Much of the political rhetoric that accompanied the passage of the National Cancer Act of 1971 has died down now. And those who, from the beginning, warned against NCI growing too big too fast are being heard. Sentiment now leans in favor of restoring a modicum of balance among the NIH institutes and bringing NCI back into the fold. Upton seems sympathetic. "Cancer is a biological problem," he says. "I can't see NCI fluorishing separate from NIH." Upton comes to his job armed not with stentorian pronouncements but with a moderate, patient attitude that may be just what NCI needs.—BARBARA J. CULLITON

China After Mao: Science Seeks to Be Both Red and Expert

The Chinese, who invented printing, gunpowder, paper, and the clock, seem about to go at it again by placing new emphasis on science and technology, and particularly on the role that they can play in the modernization of their vast country.

The leaders who have come to power since the death of post–World War II leader Mao Tse-tung in September 1976, have included science and technology as one of the "four modernizations" on which they place top priority. Chinese journals, papers, and broadcasts in recent months have been loaded with assertions about the importance of science and technology, and how scientists should not only practice their individual talents but also remember the class struggle so they can be, in one popular slogan, "both Red and expert."

The campaign to upgrade science and technology still consists mostly of propaganda, but American experts and others who have visited China recently believe that the new line presages real change in the way China spends her resources, in the technology she will seek from abroad, and in the Chinese educational system.

The emphasis represents a new crest in the up-and-down cycles science and technology have experienced in China under Communist rule. Science and technology enjoyed political favor in the mid-1950's, when China was emulating the Soviet Union, and again in the mid-1960's. But each period of favor has been followed by a downgrading, first in the Great Leap of 1958 and then in the Cultural Revolution of 1966. During the Cultural Revolution, universities were closed and scientific journals ceased publishing. When, in the early 1970's, universities and technical institutes reopened, it was without exams and with the requirement that students and their teachers go "down to the countryside" for prolonged periods to work on farms or in factories, so they would not become too "expert" and would also serve by being suitably proletarian and "Red."

Now, according to recent reports, exams have resumed in universities, and hundreds of technical journals have resumed publication. While lip service is paid to the notion of "going down to the countryside," in fact few leading scientists seem to interrupt their professional activities for such "people's" work. There is a trend for researchers to publish and talk freely about their work. Their achievements are even boasted of in the daily press.

The change in policy followed the death of Mao in September 1976, and, in October, the purge of the "Gang of Four," and the assumption of power by Hua Kuo-feng, who now holds both Mao's job of party chairman and also the job of premier, formerly held by Chou En-lai.

Political observers correlate the rise of science to prominence with Teng Hsiaoping, a leader with a strong reputation for pragmatism. Teng was prominent before the Cultural Revolution. In 1974, he was restored to power, and observers say an increased emphasis on science and technology was perceptible at that time. Suddenly deposed in February 1976, Teng has made a return in recent months. A saying often attributed to him is, "It matters not whether the cat is black or white, only that it can catch the mouse." The saying is taken to mean that ideological struggles are often less important than the goal of strengthening and modernizing China.

In line with the admonition to be both "Red and expert," one recent article in *Red Flag* said, "We must vigorously promote technical innovations and technical revolution and have the determination to see to it that our country's science and technology will catch up with the [sic] surpass advanced world levels before the end of the century. . . . Science and technology must be pushed forward, otherwise it would hobble the hind legs of the modernization of industry, agriculture, and national defense."

The new policy has interesting implications for the foreign policy of this traditionally closed nation. Previously, in the 1950's, the Chinese turned to the Soviet Union for technical assistance. Since the Sino-Soviet split, however, China has relied primarily for technical know-how upon Japan with whom it even shares common problems. Both countries, for example, have difficulty encoding the characters of their languages onto computers.

The *Red Flag* article suggests that "our policy is to learn from the strong points of all nations and all countries . . .." But "in the course of learning things from foreign countries, we must pay attention to creating the new and maintain a spirit of independence." To many people who have been to China or follow her policies closely, this means that the government may be ready soon to widen and deepen its scientific contacts beyond the brief, survey type visits it has allowed its scientists abroad.

Groups of Americans who have been to China in recent months, most particularly a group of the Committee on Scholarly Communication with the People's Republic of China, led by Philip Handler, president of the National Academy of Sciences, have tried to discuss the possibility of widened contacts in view of the Chinese self-proclaimed scientific renaissance. However, the Chinese have declined to broaden contacts at this time.

The interpretation being given to this by the Americans is that the Chinese are awaiting the outcome of the visit by Secretary of State Cyrus Vance, who will make the Carter Administration's first official trip to China in late August. Handler says, "We have asked that Vance put the question [of broadened science exchanges] on his agenda, but we don't know if he will do so. By the end of the Vance trip, the door to China will be either a little more open or a little more shut. It will not be the same."

A Change of Mood

But no matter what happens to her relations with the United States or with other countries, the lot of scientists in China seems likely to improve for the time being. Some veterans who were on the Handler delegation think they saw signs of this. Mary Brown Bullock, the staff director of the committee, says she visited with some of the same people at the Geophysics Institute that she had seen in 1974. Bullock says that the scientists formerly had sat silently in the back of the room while Institute administrators did most of the talking; this time, however, the situation was reversed. Moreover, the scientists seemed "more relaxed, more outspoken, and direct" than before. Despite the fact that they were discussing earthquake prediction, a well-known Chinese specialty, they admitted on this visit that there were things about earthquake prediciton that they still didn't understand. "There was a real change of mood," Bullock says.

Handler and other recent visitors expressed admiration for the way the Chinese are current in Western scientific literature and how well they understand problems at the forefront of Western research. The Chinese, despite their slight experimental background, seem to have a talent for absorbing foreign scientific literature, and then turning around and doing some experiment that explores the frontier of a problem.

Lewis Branscomb, of the IBM Corporation, saw some research on magnetic bubble memories for computers at the Institute of Physics in Peking. The problem was as advanced as any Branscomb knew of being explored at IBM. In another institute, he was shown a computer made entirely, he was told, of Chinese components. Despite the fact that the Chinese have not had wide experience building computers, this one was quite sophisticated in that it was capable of 2 million instructions per second and used a 48-bit word. It was similar, he estimated, to American scientific computers being built and marketed a generation before the current line.

Handler, a biochemist, visited the young Chinese researcher who had never been abroad but who led a team that recently deduced and modeled the structure of the insulin zinc dimer. Their imported equipment was simple, indeed limited, "but they had used it with great virtuosity and skill to do the job. They had done just a beautiful job," Handler said.

The Chinese, apparently, do not regard the fact that they have built only very small particle accelerators as an obstacle to their building one now that will be competitive with those built in the West. In fact, the High Energy Physics Institute in Peking is considering sites for the machine, about 30 miles from the city, and is reviewing possible designs and types. Wolfgang Panofsky, of the Stanford Linear Accelerator Center in California, visited the Institute in 1976 and held extensive discussions with his fellow physicists on plans for the machine.

American scientists who go to China, however, note that they are probably shown the experimental work the Chinese want to show off, and try to account for this in their assessments. One scientist noted that most laboratories he saw resembled those found "in the United States in the 1950's at second string universities." Another noted that the buildings that house scientific institutes are large, and seem to have few people in them, and relatively little activity. One visitor noted that he saw very few scientists between the ages of 35 and 60, an observation which suggested that the Chinese skipped training scientists for one entire generation.

Several China experts in Washington, discussing the new campaign to elevate the status of science and scientists, also noted that there will be many obstacles.

One is China's lack of any foreign money to buy sophisticated equipment from the West; China has very few exports with which to get her hands on foreign currency in quantity. Another will be the small base of manpower on which China can build; in that huge country, with a population of 800 million, only 1 in every 1300 people is attending college. (By contrast, the United States has 1 college student for every 40 members of the population.) And China has a two-tiered college educational system; most college students receive practical, vocational training, rather than a curriculum that would lead to careers in science or engineering.

But the most important obstacle to developing a strong science and technology base could be Communist political ideology. Both the perpetrators of the 1966 Cultural Revolution (who closed down the universities) and the now-dethroned "Gang of Four" subscribed to a historic element of Chinese Communism, namely, the notion that university training fosters elitism and hence class struggle. For this reason, exams were abolished for a time. For the same reason, even now, the question of whether to offer an admissions test is highly sensitive politically.

Recent visitors to China, who otherwise feel they understand what is going on, confess that they have no clear idea as to what is happening in the universities and whether technical training is being allowed to proceed in a more or less normal fashion. Even experts say it is still not clear whether China will follow the education policies necessary, in the long run, to train a new generation of experts capable of helping the country make a new leap forward.

—DEBORAH SHAPLEY

IEEE: A Policy Challenge for Big Engineering Society

The Institute of Electrical and Electronic Engineers (IEEE), the biggest of the technical professional societies, is being pressed to reexamine its policies and programs. For a case of this kind, the challenge is coming from an unusual group of dissidents. These include some of the best-known names in engineering in industry and academe: five past presidents of IEEE, a recent President's science adviser, Edward E. David, Jr., the president of Massachusetts Institute of Technology, Jerome B. Wiesner, and president of Hewlett-Packard, William R. Hewlett.

Calling themselves the Good Government Group (GGG), they have formulated a statement of "goals" which concludes with the declaration that "In order to assist the members to identify the most able leaders, we propose to seek and endorse candidates for positions as officers and Directors of the Institute" (see box).

The avowed aim of the GGG is to bolster the quality of the technical information and educational services of the IEEE, which were the institute's original functions. Members of the group share a feeling that IEEE in recent years has overemphasized "professional activities," particularly lobbying on economic and political issues affecting engineers. They argue that such efforts have been at the expense of technical and educational activities, and the result is an actual decline in the status and influence of the organization.

At this stage, both GGG members and the board are quite circumspect in discussing their differences. They avoid personal attacks and tend to talk in generalities. While the GGG wants to strengthen the technical side of IEEE, its members insist that professional activities—up to a point—are a proper concern of the organization. Board members, for their part, insist that the technical information and education functions still take a major share of the $14 million plus IEEE budget and should continue to do so. Because the argument is about balance and emphasis and, to some extent, about the criteria for choosing IEEE leaders, an outsider is likely to find some of the issues elusive. Getting a sense of the conflict is complicated by the fact that both GGG and the board endorse the same presidential candidate.

That candidate is Ivan A. Getting, president of Aerospace Corporation, who is retiring in September. Getting's selection as a board candidate is something of a departure from practice in recent years since Getting has not been an upper-echelon office holder of the organization. The GGG endorsed Getting because he fulfills their criteria for able leadership.

Getting's opposition in the presidential race is Irwin Feerst, a petition candidate who has run unsuccessfully for the presidency twice before. Feerst has been a gadfly critic of IEEE in recent years. A consulting engineer, he spends much of his time monitoring IEEE affairs and commenting through a monthly newsletter. As a self-styled champion of rank-and-file engineers, Feerst complains that the IEEE is dominated by industry executives and academics. He charges that

The Race for Veep

In the forthcoming IEEE elections for 1978 offices the key endorsement by the new Good Government Group (see accompanying story) is that of C. Lester Hogan, vice-chairman of the board of Fairchild Camera and Instrument Corporation, for IEEE executive vice president. Hogan qualified as a "petition candidate" by submitting nominating petitions with more than the required 1430 signatures before the 29 July deadline. Hogan will run against Carleton A. Bayless, division manager of Pacific Telephone and Telegraph in Sacramento, Calif., the candidate backed by the IEEE board of directors. Bayless was himself a petition candidate last year who beat the board-backed candidate and was this year endorsed by the board. The executive vice president and president are the only two IEEE officers elected by the general membership, and the executive vice president's job is regarded as the second most influential policy post.