Corporations on Campus

University-industry ties continue to grow, with mutual benefit and lingering questions about the consequences to academic openness and the influence on students

In the early 1980s, a debate flared about the effects of increased industrial funding on academic research in science. Some feared the corrupting influence of commerce, while others emphasized the need for efficient technology transfer. Today, there is little evidence that such industrial-academic connections have damaged academic mores to any major extent, although there are instances that suggest that subtle changes are occurring. An examination of what has been happening at the Massachusetts Institute of Technology and Carnegie-Mellon University, two institutions with a slant toward the hard sciences and a long tradition of cooperation with industry, indicates that even here the industrial connection is affecting the academic culture.

MIT and Carnegie-Mellon have been fertile ground for new industrial dollars in the past 10 years, apparently with few qualms about increasing sponsorship. "There's absolutely no concern with the issue of where the money is coming from, though the whole subject could use some philosophical input," observes Malcolm Gefter, an MIT biochemist. According to Ken Smith, MIT's vice president for research, industrial funding is growing faster than any other source at the Institute—rising 20% every year since 1976; it now totals about 15% of all research monies, or $36 million in fiscal year 1986. At Carnegie-Mellon, industry underwrites about 23% of the university's $100-million annual research budget, according to provost Angel Jordan.

As many university officials predicted earlier this decade, large single-sponsor programs have remained rare while research consortia have proliferated. Furthermore, the big deals that attracted most of the publicity a few years ago, such as Exxon's sponsorship of MIT's Energy Lab, have not resulted in any horror stories. Indeed, industrial funding seems to have become part of the ordinary fabric of academic life, bringing subtle changes that may or may not ever elicit the philosophical scrutiny some professors would still like to see.

"There is definitely a trend nationally for universities to be open to relationships with industry," says Edward MacCordy, associate vice chancellor for research at Washington University in St. Louis, speaking for the National Council of University Research Administrators. "It is an upward trend, though not sharp." In general, companies can acquire exclusive patent rights with prepublication review of faculty research projects, and they can stipulate the topic of study. Or, usually for a smaller price, they can set up a "window" on research that may someday give them a jump on competitors.

A look at various funding arrangements at MIT and Carnegie-Mellon shows what has become run-of-the-mill and where potential trouble spots lie.

At Carnegie-Mellon, a range of partnerships has evolved to satisfy almost any desire of corporate managers, short of an absolute ban on publication of research results. "Not everybody is interested in working with industry, but quite a few are, even those well funded by traditional sources," says provost Jordan. "In a way, they wear two hats."

One of the most prominent groups is the Robotics Institute founded in 1979. Under the direction of Raj Reddy, the institute's $9-million budget is split 50–50 between federal and industrial sources. Reddy describes his work as "applied basic research." With a multiyear grant of $250,000 to $1 million annually, a company can stipulate a particular research topic and receive the patent rights developed through its sponsorship. An "industrial affiliates" program allows companies, for $10,000 to $50,000 annually depending on their revenues, to get research newsletters and support seed projects at the institute, receiving nonexclusive licenses for technologies emerging from such projects. Groups of companies can also sponsor research in an area of interest to them and receive licenses.

Reddy says the institute has developed a fully automated, unmanned plant for making turbine blades for Westinghouse; rapid prototyping techniques for General Motors; and simulation methods for the Digital Equipment Corporation. Sponsors are given a 30- to 90-day period to review publications in order to excise information they consider proprietary. "We try to develop hypothetical data ahead of time to cover holes" in articles resulting from such censorship, Reddy says.

Prepublication review has been one of the more sensitive issues associated with industrial funding, though both Jordan of Carnegie-Mellon and Smith of MIT insist it has not been a problem. Demands for secrecy may be taking more subtle forms, however. A list of the ten largest industrially funded research projects at Carnegie-Mellon supplied to *Science* by the university's public relations office included a $992,777 grant from the Caterpillar Company to the Robotics Institute to study an "autonomous mine haulage system." Subsequently, a public relations staffer asked *Science* not to publish this research title, citing Caterpillar's objection.

A paragraph in Caterpillar's contract with Carnegie-Mellon declares that although the university is "free to publish derivative works dealing with the research performed

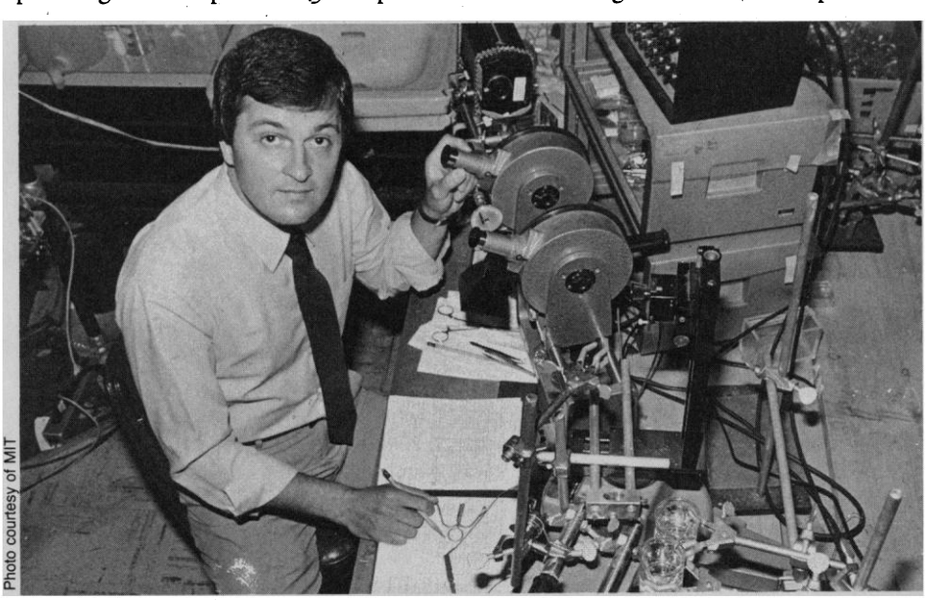

Photo courtesy of MIT

Ronald Latanision. *The director of MIT's Materials Processing Center reports that 40% of the support comes from 60 corporations, including more than 20 from Japan and Europe.*

under this agreement," publication must be delayed "until after completion of the program," which runs from March 1987 to March 1989. Publications cannot refer to Caterpillar "either directly or by implication" without prior written approval from the company. These restrictions cannot be imposed on the filing of student dissertations, however.

At the Magnetic Technology Center at Carnegie-Mellon, Mark Kryder has three funding categories to offer to industry. An "associate" membership, which costs $250,000 a year for a minimum of 3 years, brings royalty-free patent rights, copyrights to developed software, preprints of research reports, an annual 2-day conference, and placement of a scientist at the center full-time. Associate members also gain a seat on the center's advisory board. Moreover, they can dictate three topics of research to be performed. "In a way, they have control over the direction of research and policy issues," Kryder says. "We reserve a veto power, but it has never been used." Currently, IBM, Kodak, and Digital Equipment Corporation are associates.

For between $100,000 and $200,000 a year, companies can buy a "limited" membership, which gives them patents and software in a tailor-made research project. At the bottom of the hierarchy is the "affiliate" membership, described by Kryder as "essentially a monitoring relationship," that costs $50,000 a year for a minimum of 3 years.

Kryder says that when the center started in 1983, associates did not have the right to specify research topics. "Just in the past year, we gave them that ability," he notes. "At the beginning, they felt they would be putting that on us. But it's what I wanted, to get them more involved."

Kryder also says that he has gradually come to the point of discouraging recruitment of students by nonmember companies and also consultant agreements between nonmembers and the center's faculty. Kryder defends this subtle coercion of students by saying, "We're trying to preserve a benefit for our sponsors. It's a ticklish business."

"Historically, one might have feared the problem of universities doing what industry was interested in," Kryder continues. "Was industry going to demand nonacademic research? To my knowledge, this has never come up." He laments the tendency of some companies to start a project with funds from the corporate level, and then later turn the matter over to operating levels that may not feel the same commitment. On the issue of proprietary information, he maintains that "most of our work has to be relatively generic. Where there is a problem, we take a sponsored project and delay publication for patents. I have not had any pressure to do proprietary research, which companies probably want to keep internal anyway."

MIT's Materials Processing Center started in 1980 with $300,000 from the National Aeronautics and Space Administration. In those days when hopes for the space shuttle were still high, NASA's desire was for ground-based experiments to elucidate operations in microgravity, such as semiconductor crystal growth. Today, according to Ronald Latanision, director of the MIT center, NASA accounts for only 10% of the center's budget, with the Pentagon and private industry each claiming 40%.

Of some 60 corporate donors, about 10 are Japanese and some 15 are European. "Early on, professor August Witt developed a way to damp convective currents with magnetic fields," Latanision recalls about one of the research projects in crystal growing. "The technology was offered to member companies, but none of them absorbed it until Sony began producing semiconductors with magnetic Czochralski techniques." Latanision believes that the memberships can "turn out to be an empty exercise" because some companies "don't even have staff to monitor university work."

The center, like others, offers two kinds of membership to industry. For $12,500, a company can join a "collegium" and receive regular newsletters about faculty projects. For higher fees, ranging from $20,000 to $60,000 depending on a project's needs, there are "consortia" that permit placing company scientists on campus and grant various patent rights from royalty-free nonexclusive licenses to royalty-bearing exclusive licenses. With space-based manufacturing now a more tenuous dream than ever, the center has focused on such areas as ceramics and metal matrix composites. "We're interested not in corporate patrons, but in research partners," Latanision says, reflecting a 180-degree turn from traditional academic sentiment.

On the whole, there seems little reason so far to doubt that industrial money and academic talent have found a mutually nourishing world. In any case, ongoing nervousness about America's ability to capitalize quickly on technical innovations seems to have swamped the philosophical questions. "A lot of the original controversy had to do with biotechnology, where there were lots of invention and proprietary concern," says John Longwell of MIT's Energy Lab. "Working with Exxon is another thing—we're doing basic research to augment theirs."

Foreign Investors Outstrip U.S.

The debate about the effect industrial ties are having on the cultural values of academe is matched, or even exceeded, these days by the debate about why American firms are lagging so far behind their foreign counterparts who are forming an increasingly large part of the university-industry complex.

"There's an industrial culture problem that perhaps needs to be sorted out," says Ronald Latanision, director of the Massachusetts Institute of Technology's Materials Processing Center, which gets 40% of its $7-million annual research budget from industry. "American companies are often concerned about losing staff, so the people who can be spared to participate in a university research program are seen as expendable. But foreign companies feel that sending someone to MIT is an investment, and employment traditions in countries like Japan guarantee they'll return to their jobs."

"Foreign companies are much better at benefiting," says Nico Haberman, head of Carnegie-Mellon University's computer science department. "I'm often amazed that American companies are looking at short-term profits and not the longer run."

"The Japanese are very active," adds Mark Kryder, director of the Magnetic Technology Center at Carnegie-Mellon, which relies on industry for 60% of its funding. "U.S. companies find it harder to get over the threshold."

The presence of foreign companies on American campuses has raised eyebrows in Congress, which passed a law last year requiring universities to report foreign investment to the government on a quarterly basis. The General Accounting Office expects to release a study of the matter next spring.

"There's no question that there has been a lot of interest by foreign companies, because of the openness and ease with which they can access U.S. universities," says Edward MacCordy of Washington University. "Many American corporations, for reasons nobody really understands, don't value university research. It's the biggest mystery in the whole business." ■ **W.B.**

"Of course, Exxon has some ideas on what they do and do not want done," he adds. "But then so does any funding agency. We have not found Exxon to be overbearing or second-guessing." Longwell says that the company has discouraged about 20% of the projects proposed by the lab—"some they wanted to keep internal, in a few they said their interests were diminishing, such as in emission control research." He notes that Exxon's initial interest in environmental controls faded in favor of work on manufacturing processes. "When times get tough, which they are now, things like that tend to drop out," he says.

Whether Exxon and the lab's other industrial sponsors have been "overbearing," the annual summary of research projects published by the lab indicates an overwhelming interest in topics of direct value to big business. Of 144 projects listed in the 1985–1986 edition, one was related to photovoltaics and three to biomass. None of these was funded by industry.

"Our attitude has consisted in seeking out the best-of-breed departments and identifying faculty members who have individual interests that are compatible with areas we are pursuing," says Christopher Bajorek, director of technical development at IBM, echoing a typical sentiment. "In some cases, we take a more active initiative by encouraging departments to undertake research in areas they were not very active in. But nucleating an effort is not as successful as leveraging an already strong program."

Exactly what happens to universities when multibillion-dollar corporations leverage the best-of-breed departments over many years remains to be seen. "As long as we maintain a policy against secret research, then the source of funding is immaterial," Malcom Gefter offers. "Even Hoechst's $70-million sponsorship of Massachusetts General Hospital has turned out to be pretty ordinary. The pressure on a researcher to go with the money is there whether it's the government or industry, though the government may seem farther away."

Gefter and others who have been wary about industrial funding note that it still accounts for a small fraction of total research support. According to Smith at MIT, licensing income to universities from all academic science research in 1986 was just $20 million. But if corporate money on campus continues to increase at anywhere near MIT's impressive rate of 20% per year, the issue of its effect on the direction of research will become less and less academic. ■

WAYNE BIDDLE

Wayne Biddle is a Washington-based journalist who writes frequently about science and technology.

AIDS and Insects

If you can get AIDS from sharing needles, why not from mosquitoes? The answer lies in the quantity of blood

It would make a most chilling headline: BLOOD-SUCKING INSECTS CARRY DEADLY AIDS VIRUS. But there is a world of difference between harboring the virus and transmitting it.

The grim specter of insects and AIDS is in the news because of recent revelations by a Florida entomologist and Robert Gallo of the National Cancer Institute that mosquitoes can carry the AIDS virus.

Jai Nayar of the Florida Medical Entomology Lab in Vero Beach collaborated with Gallo's lab by rearing colonies of "clean mosquitoes" and encouraging them to ingest the AIDS virus, which the insects did by jabbing their stylets through a membrane of goat gut and sucking on human blood with extremely high concentrations of human immunodeficiency virus or HIV—blood that contained 1000 to 1 million times more virus than an infected person would have coursing through his body. Forty-eight hours later, the researchers in Gallo's lab were still finding infectious virus in the mosquitoes.

Reports Gallo: "Mosquitoes bite. They take blood and virus particles. It shouldn't surprise anybody that they can harbor the virus. But we have no indication that the virus replicates inside the mosquito and no evidence to show that mosquitoes can transmit AIDS."

The story was first leaked to the *Atlanta Constitution*. Neither Nayar nor Gallo knows how. Calling some coverage of the research "bizarre and irresponsible," Gallo says that television stations have run footage of him shot during the recent international AIDS conference in Washington, D.C., and made it appear as if he were giving a press conference on AIDS and mosquitoes, which he did not.

"I'm furious. I'm really, really disturbed by this," says Gallo. "All this should never have been in the media." The research results have not yet been formally published. Gallo adds that the mosquito research is "a very low priority" at the cancer institute.

Still, public concern over the matter has been piqued, and the issue is being vigorously pursued by two Florida activists who are convinced that AIDS is insect-borne. With that in mind, the Office of Technology Assessment (OTA) held a workshop 8 July to ask the question: Can the AIDS virus be transmitted by insects? The answer seems to be no, but not a completely emphatic no. Scientists want to leave the door of possibility slightly ajar. But they insist that if insect transmission is a factor in the spread of AIDS, it is an insignificant one.

For openers, epidemiologists at the OTA meeting said their data do not indicate that the AIDS virus is passed by insects. "If it's happening, it's not showing," says Harold Jaffe of the Centers for Disease Control in Atlanta.

In the United States the disease continues to plague traditional risk groups: homosexuals and intravenous drug users. If insects were a factor, says Jaffe, significant numbers of children would also be infected with the virus; but they are not, even though children get their fair share of insect bites. In Africa, where the disease afflicts men and women almost equally, AIDS remains a disease of the sexually active.

The two activists who came to the OTA meeting vehemently disagree with the assembled experts. Mark Whiteside and Caroline MacLeod, codirectors of the Institute of Tropical Medicine in North Miami, maintain that environmental factors contribute greatly to the spread of AIDS, conditions that they say explain the unusually high rate

The Miami Herald/Battle Vaughan

Caroline MacLeod. *Criticized for not substantiating her claim that mosquitoes are spreading AIDS virus.*