simply because the state controls two large empty buildings there worth over $10 million. These could be incorporated cheaply into the project, saving some construction costs. The larger one, a concrete-lined hall that used to house NASA's Space Radiation Effects Laboratory, is still faintly radioactive. Thus, von Baeyer says, "They couldn't sell it to the Boy Scouts." The other is an office building nearby that houses state educational programs, including von Baeyer's satellite branch of William and Mary. Because of NSAC's charge to do so, SURA is now reconsidering where it might build the accelerator. Among the alternate sites are Charlottesville and Blacksburg, neither of them comparable to Chicago.

An aide to Senator Percy mutters, "If they build another federal facility in Newport News, it'll slide into the river." It already has a major naval base. He suspects that the federal bureaucracy favors SURA over Argonne in part because of its convenience to Washington, its relatively pleasant weather, and its backing by Senator Warner. von Baeyer, for one, is not shy about SURA's political record, or its regional appeal. "How do you get a state legislature to commit funds to a project like this without being politically active?" he asks. Warner has been a lobbyist for the project since 1980, but von Baeyer defies anyone to find anything improper in this.

Percy's staff claims that the senator refrained from becoming involved earlier because Argonne's scientists believed that the taint of politics would hurt them in the technical review. Percy's staff now sees that restraint as mistaken, and the senator is making up for lost time. He lobbied hard to stave off a rumored phasedown of Argonne activity in 1981; now he is belatedly trying to help it compete for basic physics assignments. On 20 April Percy telephoned presidential aide James Baker and arranged for DOE secretary Hodel to appear at the meeting to be held in late May. On 23 April, a Saturday, Percy called Hodel at home and elicited a promise that no decision would be made until after Chicago had made its case. Argonne, meanwhile, is sharpening its cost calculations for a frontal attack on SURA.

How will DOE sort out these appeals? It is far from clear at this point, for NSAC's technical recommendation was only that, and this case involves some volatile political interests.

—ELIOT MARSHALL

Caltech Torn by Dispute Over Software

A young physicist resigned from Caltech after 2 years of bitter arguments whose resolution satisfied no one

For the past 2 years, a bitter argument has been raging at the California Institute of Technology over who owns a potentially valuable computer program and what constitutes a conflict of interest. The argument has involved persons at every level of the Caltech administration as well as members of its physics department. And the lasting effects of this dispute have left everyone unhappy. A brilliant young physicist has resigned from Caltech, the computer program's development has been abandoned, and rifts have grown between administrators and faculty.

At the heart of the dispute are new questions about the ownership of intellectual property that universities are only beginning to face: Should computer programs, which can be copyrighted but not patented, be treated like patentable inventions with royalties accruing to the developers? Should a university invest in a company in which a faculty member has significant financial interest? To what extent may faculty members get involved in business dealings?

Different institutions are answering these questions in different ways. But the problems at Caltech seem to stem from the fact that it is a "true community of scholars," according to its provost and its president, where issues tend to be resolved without reference to formal rules and regulations. Thus when physicist Stephen Wolfram challenged what outdated written regulations there were, he felt deeply wronged that the Caltech administration said he was not acting according to the Caltech spirit.

The story begins about 3 years ago when Wolfram, who had just joined the physics department, decided that he needed to spend some time writing a computer program. Wolfram is considered a wunderkind who was eagerly sought by Caltech. He wrote his first paper in theoretical physics at age 15 while a student at Eton, went to Oxford 2 years ahead of schedule at age 17, entered graduate school at Caltech at age 18—by which time he had already published ten papers—and got his Ph.D. in 1980 at age 20. At age 21 he received a MacArthur award—the youngest person ever to receive one.

> Vogt says, "Just as monks give up certain privileges, our faculty give up the privilege to be involved in full-time commercial ventures."

Wolfram recalls that he was motivated to write the computer program by some problems that had arisen during the course of his physics research. "I was interested in calculating Feynman diagrams in quantum field theory," he says. "Those calculations involved some very complicated algebra. One can't realistically do such calculations by hand."

There were some computer programs available that could do symbolic manipulations of the sort Wolfram required, but Wolfram found them inadequate. "The programs ran slowly but the most devastating thing was that the calculations I wanted to do overflowed the memory of the program."

So he organized and headed a group consisting of graduate students and Geoffrey Fox, a Caltech faculty member, to write a new computer program that could efficiently handle complex algebraic expressions. "I decided to make the program as general as possible," Wolfram recalls. "It was clear that there were a lot of people who could potentially use such a thing."

Wolfram and his group began writing the program in June 1980 and had a working version of a large portion of it in October of that year. It was mostly finished by June 1981. During this time, Wolfram points out, he continued to do research in theoretical physics. Writing

the program, he says, "was not my primary business."

Having written the program, Wolfram began to consider how to distribute it. "Originally, I did not plan to make money," he says. "I just wanted to get it distributed as widely as possible." He asked Rochus Vogt, who was then the chairman of physics, mathematics, and astronomy and is now Caltech's provost, for advice. Vogt set up a meeting for Wolfram with Caltech's patent lawyer, T. Lee Stam, and a person from Caltech's business office. Barry Barisch, a Caltech physicist, also attended this and subsequent meetings. "We didn't question the program's ownership but we asked what are the mechanisms for distribution," Barisch notes. "We were very naïve."

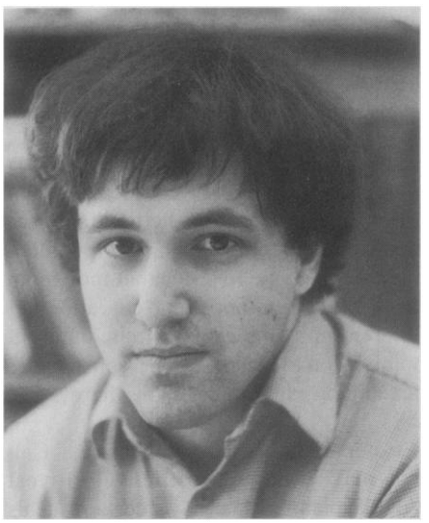
Wolfram, on the other hand, says he had looked up Caltech's bylaws and concluded that technically the program belonged to him. The policy, which was written in 1968 with textbooks in mind, stated, "Copyrights to or royalties from material produced by Faculty members as a portion of their normal teaching and scholarly activities at the Institute shall be retained or assigned by the author or authors." But Wolfram did not at first stake his claim because, he says, "I thought it would be easier if Caltech dealt with the legalities." With hindsight, he says now, "I should have asserted on day one that I feel I own the program and asked the administration, 'Do you dispute that?' "

Meetings and negotiations with Stam continued for a year. At the end of that time Wolfram, Barisch, businessman Alexander Jacobson, and graduate students Christopher Cole and Tony Terano thought they had hammered out an agreement to found a company, to be called Computer Mathematics Corporation (CMC), whose sole purpose would be to sell the Symbolic Manipulation Program (SMP) commercially and distribute it to universities. The final step was to obtain the signature of John Roberts, who was then Caltech's provost, on a licensing agreement. (Implicit in this step, of course, was the assumption that Caltech owned or at least shared in the rights to the program.)

Much to everyone's surprise, Roberts refused to sign the agreement. "This was a little remarkable," says Wolfram. "I had had the impression and so had the businessmen that when they were negotiating with Stam that he represented Caltech."

Barisch also was stunned by Roberts' refusal to sign. "We spent a lot of energy and effort working with Stam but apparently Stam had no authority. I spent one day a week for a year on this thing. It was like a consultant's job but for no pay. The idea was that when the license agreement was signed I would be paid back. When the whole thing fell apart, I resented that."

Roberts says he had two reasons for refusing to sign the agreement. First, he wanted to be sure the interests of the Department of Energy (DOE) were looked after. He knew that DOE had at least partially sponsored the work and, he explains, "If the sponsor is the government we have an agreement to protect the right to use the copyright or patent on a royalty-free basis. We took the copyright to protect the interests of the government."



Stephen Wolfram

Considers software his.

But DOE's interests were not an insurmountable obstacle. DOE contract officer Ernest Coleman says that some of the funds for running the computer were provided by DOE and the agency paid part of the salaries of some of the graduate students working on the programs. In such a case, DOE would want to have access to the program without paying royalties but it would not necessarily insist that Caltech retain the copyright to the program nor that it refuse to license the program to a company like CMC. "The policy of the government is to reward more and more benefits to the people who develop the programs," Coleman says.

Roberts' second reason for refusing to sign was more substantial. He wondered whether it was proper for the university to enter into an agreement with a company in which Caltech faculty members had substantial stakes. "A faculty committee was working out a conflict of interest statement for faculty approval. We were in a transition period. My view was that we needed to get all this straightened out before we licensed this copyright," he says.

At this point, Wolfram and Roberts began to feud, with Wolfram arguing that in fact the copyright did not belong to Caltech. By all accounts, neither Wolfram nor Roberts made any attempt to be diplomatic or even polite in their dealings with each other.

Wolfram appealed to Caltech president Marvin Goldberger, he spoke on numerous occasions to Donald Fowler, Caltech's general counsel, and he argued with Roberts, but to no avail. Three eminent physicists in Wolfram's department—Richard Feynman, Murray Gell-Mann, and George Zweig—tried to mediate but they, too, failed. Vogt, who was at that time still head of physics, mathematics, and astronomy, tried in vain to make Wolfram understand Caltech's position. "You have no idea how much time I spent—*unbelievable* hours—on the Stephen Wolfram affair," Vogt says.

During the 2 years of arguments over the fate of the computer program, Caltech changed its bylaws to state that if the institute or a funding agency finances, in whole or in part, a project resulting in copyrightable material—including computer software—then the institute owns the copyright and obtains the royalties unless other arrangements are made in advance. It also put out a statement on conflict of interest saying, in part, "the Institute should not make licensing agreements that pose a real or potential conflict of interest with respect to the obligations of any Faculty member or of the Institute."

Wolfram points out, however, that these regulations were made too late to apply to him. And, in the end, the situation deteriorated to such an extent that Wolfram felt he was forced to resign from Caltech. He had been told repeatedly that Caltech's position is that it owns the copyright on the program and that it will not give an exclusive license to a company owned by Caltech faculty. Moreover, any royalties would go to the high energy physics group—not to individual inventors. Wolfram was given an ultimatum: Resign from the company or resign from the university. He chose to resign from the university.

His resignation was effective at the end of October 1982 and he accepted a position at the Institute for Advanced Study in Princeton effective in January 1983. As a condition of his employment, he requested and got a letter from the institute waiving its rights to any inventions he might produce. Meanwhile, he

still has substantial stock in CMC and maintains that he is considering suing both CMC and Caltech.

To date, a few aerospace firms have paid the $40,000 price for the program that CMC is charging commercial users. And Caltech has let a couple of universities use it. But the program is not being aggressively promoted, nor is it undergoing the development it needs to make it valuable to university researchers.

Barisch remarks, "The probability that the program evolves in a healthy way so that it is useful for theoretical physics problems—I don't think it will. There is no more effort at Caltech. I and others have washed our hands of it." One physicist says, "The program has an enormous amount of potential. If it can be made bug-free and distributed it can be enormously helpful. But the program can't really be polished and nurtured; it can't flourish or grow in this environment."

What would have happened if Wolfram had been at another university when he developed the computer program? At Stanford, says Patricia Devaney, associate dean of graduate studies and research, the current policy on computer software copyrights is that they must be assigned to the university. But, she says, "we are in the process of revising our policy." Stanford plans to let faculty members who design computer programs keep the copyright, thus making its policy on software more like its patent policy. Devaney explains that the revised policy says that "title does not have to vest in the university simply because the inventor used considerable university resources." This new policy, however, is still in draft form and has not been put into effect. Stanford faculty are allowed to invest in corporations, and to consult one day a week. There is no restriction on the nature of their involvement so long as it does not conflict with their obligations to Stanford.

At the Massachusetts Institute of Technology, says Kenneth Smith, the associate provost and vice president for research, the university claims the copyright on software but shares the royalties with the inventors. The royalties are shared on a sliding scale, depending on how much money is involved, but most of the money goes to MIT. Faculty at MIT may be involved with outside corporations as long as they disclose their activities and as long as their primary loyalty is to MIT.

Carnegie-Mellon University, like Stanford, is in the process of developing a new policy on intellectual property. There is "a lot of confusion" about the current policy, says provost Daniel Berg, because decisions are made on a case-by-case basis. According to Carnegie-Mellon's proposed new policy, the copyright for computer programs would belong to the developers unless considerable university resources were used or unless the programs were developed under a contract that specifies that the copyright belongs to the contracting agency. If considerable university resources are used and the university claims the copyright, it will give 75 percent of the royalties to the inventors.

Faculty at Carnegie-Mellon are encouraged to start outside companies. "We have given rights to software and have given loans for equipment," says Berg. But if faculty members become involved in starting companies, they are asked to take a leave of absence. "At most, they can take 2 years leave. Then they have to decide whether they are faculty members or officers in a company," Berg says. He notes that individual cases often are not clear-cut and that different universities have quite different opinions on the issues. "In a sense we're developing a common law here," he says.

Compared to other universities, Caltech may seem a bit restrictive. Provost Vogt explains, "We have certain ideals here—certain goals. Faculty should serve education and research. Just as monks give up certain privileges, our faculty give up the privilege to be involved in full-time commercial ventures." For those who feel it necessary to participate in business ventures Vogt advises, "There are many splendid places that allow these outside activities. They should go there." President Goldberger says he shares Vogt's views.

Vogt says that Caltech faculty should not have to see written regulations on the institution's ethics. "I don't think you ever have to explain it to someone. You absorb it."

To Vogt, the real tragedy of the Stephen Wolfram affair is that neither he nor the other Caltech administrators even could communicate their vision of Caltech to Wolfram. "I think Stephen is a brilliant young man whom Caltech has nurtured along," Vogt says. "Until this commercialism took place, Caltech was an *ideal* place for Stephen. He is exactly the kind of character that we want to take care of. The fact that Stephen ultimately left and became very embittered—there is no doubt in my mind that this is detrimental to his research. All other things pale in comparison. This man should spend his time in scientific dialogue. It's very sad."—GINA KOLATA

Commerce Deputy Resigns Over Satellite Sale

It has always seemed curious: in April 1982 the Cabinet Council on Commerce and Trade recommended against selling the government's weather satellites to a private operator, and then in December 1982—despite innumerable studies that said the transfer would be a bad idea—the council reversed itself without explanation. (*Science*, 11 February, p. 752)

Guy Fiske

The controversy could sink the proposal

Some light was thrown on the matter in hearings before the House science and technology subcommittees on 14 April, when Commerce Secretary Malcolm Baldrige admitted that his second-in-command, Guy W. Fiske, had been entertaining a job offer from the Communications Satellite Corporation (COMSAT) at the same time he was overseeing the department's debate on the transfer. COMSAT originated the idea of the weather satellite transfer in 1981, and has been lobbying hard for it ever since.

Fiske removed himself from any further role in the satellite decision at that time; last week he resigned, effective 14 May, thus forestalling a congressional conflict-of-interest investigation. However, the Justice Department has now launched a criminal investigation of the matter.

Fiske admits to being unwise about "the potential for the appearance of conflict," but denies that his contact with COMSAT had any influence on