Harvard and Monsanto: The $23-Million Alliance

Late in 1974, after negotiating for more than a year and a half, Harvard University and the Monsanto Company entered into an agreement that is unprecedented in the annals of academic-business affairs. Under the terms of the agreement, which neither party will reveal in full, over a period of 12 years Monsanto will give Harvard Medical School $23 million in research support and endowment money. In return, Harvard has given Monsanto the patent rights to the fruits, if any, of research on a controversial biological substance called TAF, for tumor angiogenesis factor, that is reputed to regulate the growth of blood vessels and, as a result, the development of cancers that need a supply of fresh blood in order to grow. TAF may or may not exist.

The fact that Harvard and Monsanto had signed an agreement was first made public in February 1975 when a Boston paper carried the story. About the same time, Monsanto president John W. Hanley commented publicly on the agreement, calling it a "novel and imaginative approach to innovation and technology transfer problems in today's complex society." But beyond that, neither Harvard nor Monsanto officials would say much about what they had agreed to, and the Harvard faculty, with academics' inborn suspicions of big business, saw the arrangement rather as a "novel and imaginative" way for the university to sell its soul.

Early press accounts of the $23-million deal still make officials on both sides shudder. In particular they recall one story that ran with a banner headline proclaiming: "Harvard Medical, Monsanto Join In Historic Project on Cancer." However, in a short time the matter faded from public view, although skeptics on the Harvard faculty continued to gossip and grumble among themselves. Then, curiosity was roused again last month when Monsanto, a St. Louis–based chemical company, issued a press release announcing the formation of a five-man advisory committee "concerned with the public interest," whose duty it is to see that both sides honor their contractual promises to protect academic freedom—namely, the right to publish—and to develop any products that may emerge in a manner consistent with the public good—which is to say, for instance, that, if TAF research leads to a cure for something or other, the company will not sell it at an unduly inflated price.

In the absence of solid information about the details of the Harvard-Monsanto arrangement, skeptics are not entirely reassured by the creation of a public interest advisory body. "If everything is on the up and up," one faculty member asked, "why do we need a committee for civic virtue?" Even now, the persons who can answer that question are reluctant to do so and it is apparent that Harvard and Monsanto each consider their agreement a "delicate and sensitive" proposition.

Monte C. Throdahl, group vice-president for technology at Monsanto, is the company's point man for this joint undertaking. At Harvard Medical School, associate dean Henry C. Meadow is the man in charge. The principal researchers are M. Judah Folkman, a surgeon, and Bert L. Vallee, an enzyme biochemist. Throdahl's initial response to an inquiry from *Science* about the agreement was defensive. "I don't have much to say beyond what's in the press release," he said, referring to the brief document which lists the advisory committee members and describes the research only as a project which "deals with the biology and biochemistry of organ development." When pressed, Throdahl went on to explain that Monsanto is feeling a "little gun-shy" from publicity it considers erroneous and said that further comment in the press might hurt the arrangement between the company and the university which he described as a "fragile flower just ready to bloom." Then, conceding that to say nothing would lend credence to the suspicion that there is something wrong about the agreement, Throdahl said he would think overnight about granting *Science* a substantive interview. The next day, after talking first with Meadow, Throdahl consented. Meanwhile, Meadow, who later admitted he was not exactly delighted by the inquiry, agreed to meet with this reporter in person.

There is a mystique in science that things should always be completely open—probably reinforced because federal money is usually involved—but it was not operating here. Although Throdahl and Meadow cooperated as much as they felt they could, providing information about the origins of their coming together and the general nature of their agreement, they decided after conferring on the matter that they would not discuss the details of the business contract. "Who pays what to whom," as Throdahl put it, was something *Science* would have to learn elsewhere.

The scientists were equally reluctant to talk about the nature of the research. Vallee said through his secretary that he would be out of town or otherwise unavailable for several weeks. Folkman did agree to a personal interview but had to cancel it just 3 hours before it was to take place. Later, by telephone, he said that he has not given an interview for more than 4 years, when his work hit the papers after a presentation he made at an American Cancer Society writers seminar in 1972. "Publicity has a terrible effect on patients," he said, "who believe we're much closer than we are and who call, or sometimes just show up, expecting that we can help them. I really do not want to talk about the work until we have something new to say."

Officially speaking, Monsanto and Harvard try to steer conversations about the research away from the "tumor" part of TAF experiments and emphasize the potential value of studies of "angiogenesis factor—AF" to blood vessel disorders in general. The Harvard public relations office says Folkman is doing "basic cell research," and Meadow says that references to cancer make the investigators "see red." But the fact remains that, to date, the research really is primarily related to cancer and it is hard to pretend otherwise.

In any case, from a combination of official comment and "not for attribution" information from a variety of sources, the following account of the extraordinary Harvard-Monsanto agreement was pieced together.

Negotiations for the $23-million Harvard-Monsanto deal began tentatively in 1973. Federal support for research and training had been declining for several years, and there was no reason to count on things getting better. Harvard president Derek Bok was among those academic statesmen who were talking about universities forging new alliances with the private sector, and the medical school was certainly willing to consider the notion seriously. About the same time, Throdahl reports, Monsanto, which does a lot of work in agricultural

Senate Tunes Up Committee System

The Senate's effort to reform its committee system culminated on 4 February in the adoption of a compromise which modestly reduces the number of committees and introduces a variety of efficiency measures. A net effect of the changes is to put science, energy, and environment matters into sharper focus in the Senate.

The Aeronautical and Space Sciences Committee was one of three standing committees abolished—"consolidated" was the word used—as part of the final compromise. The Post Office and Civil Service Affairs Committee and the District of Columbia Committee were the two standing committees, whose functions were taken over by other committees; four select committees and joint committees were also consolidated.

The Aeronautical and Space Sciences Committee was established in 1958 to oversee the nascent space program. It shared jurisdiction over science policy matters with the Commerce and Labor and Public Welfare committees. Jurisdiction over space activities was transferred to the Commerce Committee, which has been transformed into the Commerce, Science and Technology Committee chaired by Senator Warren G. Magnuson (D–Wash.).

Legislative authority over the National Science Foundation will remain in the new Human Resources Committee, which is the consolidated form of the old Labor and Public Welfare Committee. Senator Edward M. Kennedy (D–Mass.) will continue to head subcommittees responsible for both biomedical research and the National Science Foundation. Senator Harrison A. Williams (D–N.J.) is chairman of the full committee.

The major impact of reorganization will be in energy matters. As it has in the House, the demise of the Joint Committee on Atomic Energy has brought a redistribution of authority over nuclear energy in the Senate.

Jurisdiction over both fossil-fuel and nuclear energy is concentrated in the new Committee on Energy and Natural Resources, the new incarnation of the Interior Committee. Chairman of the new committee is Henry M. Jackson (D–Wash.), who, as one Senate staff member said, now has "a hammerlock on energy in the Senate."

Responsibility for legislation on the regulation of nuclear energy, however, was given to the new Committee on Environment and Public Works. This is the consolidated form of the former Public Works Committee. The chairman is Jennings Randolph (D–W.Va.).

Military applications of nuclear energy go to the Armed Services Committee and responsibility for the foreign policy implications remains with the Foreign Relations Committee.

Although the major new committees have not formally reorganized since the final action on the committee system because of a recess, it appears that the major players in science, energy, and environment matters in the Senate remain the same and, if anything, have gained influence.

The Select Committee to Study the Senate Committee System, chaired by Senator Adlai E. Stevenson (D–Ill.), proposed a reduction of Senate committees and joint committees of from 31 to 15. The Senate voted finally to reduce the number of committees to 25 with a proviso that at the end of the year three more panels may be dropped—the Nutrition, Joint Printing, and Joint Library committees.

The unwillingness of the senators to make larger reduction in the number of committees came as something of a disappointment to reformers but hardly a surprise. Stevenson's committee had been aware of the practical difficulties in making cuts requiring senators to lose chairmanships and control of staff and had avoided making proposals impinging on Senate power centers such as the Finance Committee.

Efforts to modify the Senate seniority system were turned back as discussion of the reorganization progressed. But the compromise measure does promise to increase efficiency in the way the Senate does business by reducing the number of committees and subcommittees on which a senator may serve, and by providing for a computerized scheduling system to reduce the conflicts which often turn the senatorial day into a frustrating round of committee hopping.—J.W.

chemicals, was thinking about expanding into biological areas without necessarily opening a pharmaceutical division. As he described it, "We've been looking for large world problems we could solve with our skill base," but, when the company thought about establishing a major biological research branch of its own, it discovered that "biochemistry is the province of the universities, and not many biochemists were interested in coming to industry. We realized we couldn't build a biology department by hiring people away from the medical schools, so we thought about collaborating."

Here, Bert Vallee of Harvard's Peter Bent Brigham Hospital enters the picture. Vallee, 57 years old, has had a long and distinguished career studying the relationship between trace elements, often found in only minute quantities in biological tissue, and disease. Elected to the National Academy of Sciences in 1974, he has a solid reputation as a biochemist and is said to be very good at characterizing substances that are difficult to identify. For years, Vallee has been a corporate consultant to Monsanto, and so, as Throdahl noted for *Science*, it was natural that the company should discuss its interest in biology with him. Thus, the Harvard-Monsanto connection was made. For introductions, Vallee was the key. Judah Folkman's theories, and Monsanto's willingness to gamble on them, were the key to putting the deal together.

The Science

Moses Judah Folkman, who for some reason is always described as the son of a rabbi and the youngest man ever appointed a full professor of surgery at Harvard (he was 34 years old at the time of his appointment in 1967), is surgeon-in-chief of Harvard's Childrens' Hospital Medical Center. Several years ago, Folkman began working the idea—known but unexploited for 100 years—that solid tumors (as contrasted with malignancies of the blood or lymph systems, for example), cannot grow unless they are vascularized. Folkman postulated the existence of a chemical signal, TAF, that tumors send out to stimulate the growth of new blood vessels. Among his most dramatic experiments to demonstrate TAF's existence are ones in which a tumor is surgically implanted in the cornea of a rabbit, where there are no blood vessels. Within a week or so, tiny capillaries from the nearby iris begin to penetrate the cornea, heading for the tumor implant. Once the blood vessels reach it, the tumor grows rapidly, becoming as large as the eye itself within 4 weeks.



Dr. M. Judah Folkman

Conversely, if pieces of tumor are implanted in the liquid-filled anterior chamber of the rabbit eye, where new vessels cannot reach them, they remain dormant.

From 1969 through about 1972, Folkman wrote and spoke a lot about his observations. An engaging, enthusiastic speaker, he produced a fascinating film of the phenomenon that drove his point home all the more to various audiences of scientists and reporters across the country. His proposed mechanism for tumor growth and for possibly controlling it was appealingly simple. If tumor angiogenesis factor somehow elicits blood vessel growth, then anti-TAF, an antibody or inhibitor of some kind, would surely stop tumors from growing.

Folkman's conviction that he is on to something of major importance is, his colleagues say, as strong as ever, but the more hard-nosed of his acquaintances in the scientific community have maintained for a couple of years that, if TAF is real, it should have been purified and characterized by now. As one NIH study section member who has reviewed some of Folkman's grant applications put it, "I believe that anyone who has a 'factor,' which means they don't know what it is, has 5 or 6 years to prove it. After that, I stop reading about it."

There have been instances when Folkman's critics have succeeded in preventing him from getting certain grants, not necessarily because they see no merit in his ideas but because they ranked other proposals higher. But still, he has and continues to receive support from the National Institutes of Health (NIH). In fact, a grant titled "Tumor angiogenesis, a control point in tumor growth," has just been renewed for 3 years at $135,000, $144,000 and $155,000, respectively—even though NIH was well aware that the Monsanto agreement is in force. Needless to say, this is a sore subject with some study section members who think Folkman and Vallee should drop out of the NIH pool. But Folkman maintains that there are some kinds of things not covered by Monsanto—just as there are some that would not be covered by NIH, such as an electron microscope of his own for the lab—and, he has said, he does not want to be out of the process of peer review.

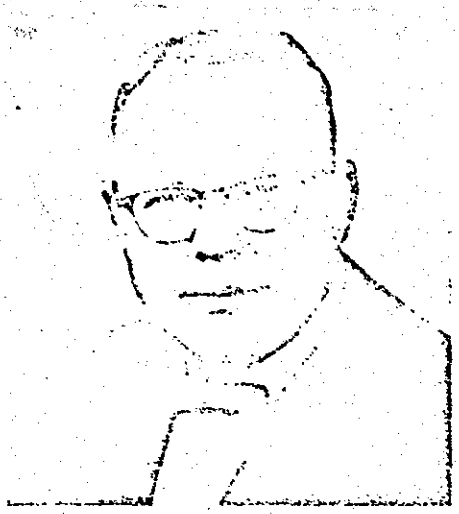
Folkman has had some difficulty getting papers on TAF published in refereed journals, including the *New England Journal of Medicine*. Thus, he cites an article in *Scientific American* (May 1976) as a major recent publication. Promoted by the magazine to certain reporters as one of the hottest items it has published in a long time, the article brings the work up to date and offers some ideas about blood vessel growth generally but contains little in the way of new data. A second recent Folkman paper, describing the isolation of a "factor" from cartilage that inhibits tumor vascularization appeared as a report in *Science* (2 July 1976).

Folkman's Harvard colleagues, both believers and disbelievers in TAF, say his strength lies in dreaming up imaginative ideas, not in producing hard biochemical data. Throdahl and Meadow each refer to Folkman as a man "who reads the book of nature" and to Vallee as the fact man, who brings us back to the connection among the four of them.

About the time that doubters were beginning to want real proof that TAF exists, Folkman was brought together with Vallee, a man with a reputation for leaving nothing to the imagination. If TAF is real, Vallee will prove it, it is said.

No Peer Review

That is the way things stood when Harvard and Monsanto, through Meadow and Throdahl, began to talk about collaborating. Throdahl had confidence in Vallee from years of prior association and he was impressed by Folkman, an "inventor, a genius, a beautiful person." Besides, from the company's point of view, if the research was successful, there might be a number of useful agents as a result, therapies not only for cancer but also for arthritis and other diseases that inflame blood vessels. So, in this way, the scientists who would be the focal point of a unique venture for the university and the company were chosen. The time-honored system of peer review on which researchers rely so mightily was not called into play, and each side moved forward on what some of Folkman's peer reviewers call an act of faith. It is impossible to say for certain but it is entirely likely that, if faculty committees and peer review and public comment had been part of the picture in 1973, the negotiations might not have been completed successfully.



Dr. Bert L. Vallee

Publishing Rights and Patent Policy

In reaching an agreement for joint research, Meadow and Throdahl had to try to reconcile the clearly divergent philosophies of academe and big business. As Meadow put it, "A university is supposed to serve society evenhandedly; a company is supposed to make money for its stockholders." But each side wanted the negotiations to succeed and each made concessions so that they could.

Meadow was insistent that the researchers be free to publish whatever they wish as soon as they wish. Monsanto agreed. Monsanto, on its part, wanted to secure patent rights to products or research processes that might emerge and in this ran into an antithetical university patent policy.

For years, Harvard (like many universities) adhered to a simple patent statement that said "No patents primarily concerned with therapeutics or public health may be taken out . . . except for dedication to the public." Harvard's patent policy has changed. Although officials do not say that the policy changed *because* of the Monsanto negotiations, university counsel Daniel Steiner says that the agreement could not have been concluded under the old policy unless the Harvard Corporation granted an exception. As things happened, Harvard changed the rules.

Steiner reports that, given the emphasis that is being placed on "technology transfer" generally and on the realities of resources needed to take any discovery from research through development, Harvard's "laissez-faire" patent policy was "foolish." As of the early 1970's, he says, other academic institutions began changing their policies and Harvard saw no reason to remain "behind the times."

DNA: Laws, Patents, and a Proselyte

The strongly running tides of legislation that lap around the technique of gene-splicing with recombinant DNA molecules ebbed and flowed last week in the following actions.

At Cambridge, the City Council closed the books, or at least a chapter, on its 8-month confrontation on the issue with Harvard and MIT. At a meeting on 7 February the council rejected by a 6-to-3 vote a proposal by Mayor Alfred Vellucci to ban the research altogether. By unanimous vote, Vellucci included, it then adopted into law the recommendations of its citizens' review board, which allow research to proceed under the NIH guidelines but with a few extra restrictions (*Science*, 21 January). But the council added further restrictions. One is to ban research requiring the highest, or P4, level of physical containment. All P3 research must use disabled (EK2) organisms. And premises used for P2 and P3 research must be effectively free of rodent and insect infestation, failing which the facility can be ordered closed by the city's health commissioner.

This stipulation may present a problem for Harvard. The Bio-Labs, home of the P3 facility which has occasioned the whole brouhaha, is infested with a seemingly ineradicable species of ant. But the P3 lab, according to its chief designer Mark Ptashne, "has been built at extra expense to make sure that there will not be any insect problem." Ptashne says of the council's decision that "basically it vindicates our position, although there may be some technicalities of wording that the opponents can exploit. To the extent that these will be decided by the health commissioner and not become a political football, research can go ahead all right." The city council's action lifts the moratorium on P3 research that had been in effect since last July, although the moratorium on P4 is in effect continued.

Another regulatory kerfuffle, this time arising from differences of motive between bureaucratic fiefdoms in Washington, has centered round a patent regulation issued by Betsy Ancker-Johnson, Commerce Department assistant secretary for science and technology. The regulation allows accelerated processing for patent applications involving gene-splicing research, but exempts applicants from disclosure—an important requirement of the NIH guidelines—if their foreign patent rights would be jeopardized. Senator Dale Bumpers (D–Ark.) wrote Ancker-Johnson protesting that her action preempted the discussions now going on in government as to whether the NIH guidelines should apply to industry (*Science*, 11 February). Secretary of HEW Joseph Califano last week wrote to Ancker-Johnson's boss, Secretary of Commerce Juanita Krebs, asking that the order be delayed.

Whose idea was it in the first place? Apparently an industry source suggested the idea to the NIH, which passed it on to the Department of Commerce. Ancker-Johnson sent a draft of her order to the NIH 6 weeks before its publication in the Federal Register last month but received no objection. Joseph Perpich, an aide to NIH director Donald Fredrickson, says the NIH didn't comment on the order "because we didn't think they were going to act on it." He notes that the Commerce Department is represented on the interagency committee considering the gene-splicing issue. The committee is preparing legislation of its own.

The committee has been anticipated on this issue by Senator Bumpers. He introduced a bill on 4 February that would require the government to issue licenses to those doing gene-splicing research, and a similar bill has been introduced in the House by Representative Richard Ottinger (D–N.Y.). Introducing the bill, Bumpers declared that the pharmaceutical companies in this country "are in a mad, head-long rush" and that "virtually none of them is complying with NIH guidelines." Asked for evidence of this statement, a Bumpers aide said the senator had meant to say that the companies are not at present compelled by law to follow the guidelines.

Bumpers also shared with his colleagues on the Senate floor some views on the religious implications of DNA. Bumpers had found the subject one of the most interesting he had ever studied. So much so, he said, that "If a man has a tendency to be atheistic, if he reads very much about DNA, it will almost certainly change his spiritual thinking."—N.W.

Under its new policy, adopted in June 1974, it is permissible, under certain ground rules, for the university to assign patents to industry.

But more important in the long run, perhaps, Harvard's new patent policy is aggressive, placing a real obligation on the scientist to let the university know if research is leading to a patentable product. The implications of this new requirement to speak up have yet to be measured, and the university is moving slowly in this area while it considers complex questions such as whether it should establish its own patent office.

The patent situation was not the only aspect of the business side of the agreement that demanded some fresh attitudes on the part of the negotiators. In keeping with its commitment to the "public good," Harvard wanted, and got, assurances from Monsanto that, if there was anything to develop, the company would do so quickly and economically. One job assigned to the public interest advisory committee is to see to it that Monsanto honors that part of the bargain.

Choosing the members of that advisory committee was, apparently, as delicate a part of the negotiations as anything else. Harvard officials take credit for proposing the idea of a committee, which was written into the original 1974 agreement, but praise the company for accepting it willingly. (Hale Champion, recently named deputy secretary of Health, Education, and Welfare, was among the Harvard leaders who suggested the advisory committee.) But, when it came to choosing members, it sounds as if each side had what amounts to the right to peremptory challenge of the other's suggestions. As Throdahl points out, Monsanto did not want persons whom it felt to be biased against industry and Harvard could not accept anyone it thought lacked respect for academic principles. "We also had to get people who had no association with either institution (though Harvard graduates were not ruled out) and who were *sympathetic* to the idea of a joint project. It took us a year to find them all," he notes.

William D. Ruckelshaus, Jr., senior vice-president of Weyerhauser Company in Tacoma, Washington, and former administrator of the Environmental Protection Agency, and Frank Stanton, chairman of the American National Red Cross and former vice chairman of CBS, Inc., have the credentials for being knowledgeable about the ways of business but also patrons of the public interest. The three scientist members, Paul J. Flory, a Stanford University chemist; Alton Meister, a biochemist at Cornell medical school; and Maxwell M. Wintrobe, a hematolo-

gist and clinician at the University of Utah medical school, are all members of the National Academy of Sciences. So far, the group of has met once—in early January at a get-acquainted session. It is not yet certain how frequently it will meet or whether its public interest meetings will be open to the public.

The Money

As for the money in this arrangement, $23 million is a tidy sum for Harvard Medical School but, spread over 12 years and being largely tax-deductible as a business expense or charitable contribution, it is probably not such a major amount for the nation's 38th largest company whose annual sales in 1974 were in the neighborhood of $3.5 billion.

For the present, Folkman and Vallee each get a research sum of about $200,000 a year, guaranteed for the 10 years remaining in the contract, but that amount is likely to rise to accommodate inflation as well as anticipated progress. Further, Harvard is getting an undisclosed sum, which *Science* calculates to be at least $12 million, in endowment money, to be used now to support persons affiliated with the Folkman-Vallee research but, ultimately, to be used as general, string-free funds. In addition, Monsanto is equipping laboratories on one floor of a new Harvard building—a $1.4-million proposition. Much of the remainder can be accounted for by the materials Monsanto is supplying for the research. Specifically Monsanto, with its industrial facilities for producing things in quantities no university could manage, is supplying huge amounts of culture media and other biological materials that, presumably, will contribute to the successful purification of the elusive factor.

Some observers, particularly those at other universities, see the Harvard-Monsanto agreement as precedent-setting or in any case they hope it will be. Even the Monsanto press release on the advisory committee raised that possibility when it said, "Committee members have expressed the hope that their activities may eventually serve as a model for others who embark on a similar industrial/academic project in the future." Certainly, the idea of getting a lot of money from industry, a previously underdeveloped source, is appealing to both universities and individual researchers who would love to have the long-term security Monsanto has given Folkman and Vallee. But it is not at all clear that the Harvard-Monsanto relationship is one that can be easily copied.

In establishing a joint program, Monsanto made it clear that it wanted two things: the first, and probably most compelling, is a piece of the action on TAF. Although the agreement is between the company and the university, it focuses most specifically on Folkman and Vallee and includes a provision about what would happen were either of them to leave or die. Harvard must provide some investigator, acceptable to Monsanto, to take over. Otherwise either party could cancel the agreement. Secondly, Monsanto insists that from its Harvard collaboration it is learning a lot about biological research that it might otherwise not know and that this too is important to the company. Surely it is a more certain prospect than any product resulting from TAF, which Monsanto admits is a risky proposition.

It is hard to predict just what effects arrangements of this sort would have on medical schools were they to become common. Obviously, the agreement introduces an element of free enterprise into the system that can fairly be described as different. Questions abound. Would it undermine peer review? Would it lock the university into business deals it ultimately might not like? If one such arrangement is acceptable, would many subtly work against academic freedom in ways no public interest committee could fully guard against?

No one knows, but Harvard, obviously, is willing to take its chances. Counsel Steiner thinks the agreement should be applauded as a step bringing industry and academe together and says frankly, "I'm proud of it." Meadow, who negotiated so long, suspects that the setup may not be reproducible, but, when asked whether he would be willing to try to recreate it were another company to come along, he replied, "You bet."

—BARBARA J. CULLITON

Frank Press, Long-Shot Candidate, May Become Science Adviser

A dark horse whose name was not even mentioned in previous public speculation has emerged as the leading candidate to serve as science adviser to President Jimmy Carter. He is Frank Press, a 52-year-old geophysicist who currently heads the department of earth and planetary sciences at the Massachusetts Institute of Technology (MIT).

Although Press is chiefly known in public policy circles for his work on seismic detection of underground nuclear tests and his strong advocacy of a national program to develop earthquake prediction capabilities, he has had a fairly broad range of advisory experiences at the national and international levels. That background, some say, would make him an effective force in the Carter Administration.

The strong signs that a science adviser would soon be named sent sighs of relief through the science policy community, which has been dismayed at the Carter Administration's slowness in filling the post. The earlier a science adviser is appointed, the better the chance he will have to exert influence over other key scientific appointments in the various agencies and departments and over the Administration's emerging policies on technical issues. Many scientific leaders expressed particular satisfaction in the choice of Press because they believe that he would contribute important strengths to the Carter team, particularly in such areas as arms control, international relations, and earth resources—all items of high-priority interest to the new President.

Press met with Carter at the White House on 9 February for a half-hour conversation about the job. So far as is known, he was the first—and only—scientist to be called in for such an interview. No one else was present, and few details of what transpired have leaked out. Press, who is being circumspect about the whole affair, told *Science* he had "a very agreeable conversation" with the President and "walked out with a very warm feeling," but without a firm job offer. Beyond that, he would not comment. Others close to the situation report that, by the end of the conversation, Carter was impressed enough to ask Press to prepare a paper setting forth his vision of the job. The paper that