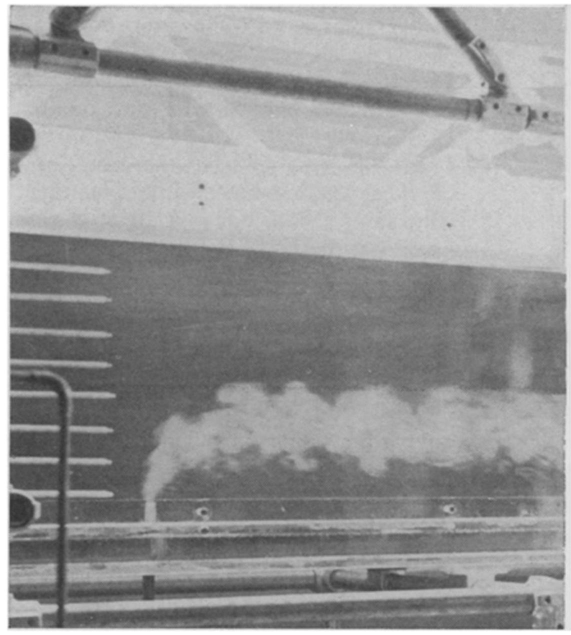
A physics lab goes relevant



Military research is being replaced at MIT's Fluid Mechanics Laboratory, but funding is the big problem

by Peter Gwynne

Can a university department heavily involved in defense research find happiness—and funds—by switching over to socially oriented research?

Until last year the question would hardly have been considered worth asking. Departments involved in military research had a regular source of income, a steady supply of students and little desire to move away from their specialty. Research into social problems was generally regarded as a non-academic pursuit for industrialists and government agencies.

Last year, however, saw growing recognition among U.S. scientists of the need to apply their expertise to the pressing problems of the cities and the nation. Springing originally from the scientists' and engineers' organizations in the election campaign, the movement to involve scientists in everyday problems grew rapidly, culminating in the March 4th research stoppage at Massachusetts Institute of Technology and other campuses across the nation (SN: 3/15, p. 257) to protest the links between the universities and the military, and subsequent steps to limit defense orientation both at MIT and Stanford University.

But a decision to limit attention to defense programs is only half the answer for a laboratory, unless it wants simply to die. A fair number of researchers involved on defense-supported astronomy and physics projects found themselves at loose ends last year when budgetary restrictions led the military to cut them adrift, and no other Federal agency was able to muster the funds needed to take up the slack (SN: 7/6/68, p. 6).

The other half-answer must be: What does a research laboratory do, other than disappear, once it has severed the silver cord that has bound it to the Defense Department for a quarter-century or more?

Surprisingly, MIT administrators could find a guide to that half-answer in their own family.

The university already boasts one laboratory that, on its own, has changed from predominantly defense work to research with a definite social impact, and has managed to survive. This is the Fluid Mechanics Laboratory, a branch of the university's mechanical engineering department. At the beginning of 1966 the laboratory contained six professors and 20 graduate students, specialized in reentry physics, which although unclassified had obvious application to defense problems, and worked on a budget of approximately $300,000 per year.

Today the laboratory's 10 professors and 30 graduate students are studying such topics as the design of smokestacks, the fluid mechanics of the human body, desalination and the combustion process in automobiles, in addition to the reentry physics, and its research budget has soared to about $600,000 per year.

A defense contract from the Office of Naval Research remains the largest single grant in the laboratory. But at present, 14 contracts from 14 different Federal agencies are keeping the non-defense work going, with some additional support from MIT itself.

The leaders of the change were Dr. Ascher H. Shapiro, head of MIT's mechanical engineering department and an expert in jet engine research; Dr. James C. Keck, a nuclear physicist who had specialized in the development of nuclear weapons and ballistic missiles; Drs. James A. Fay, and Ronald F. Probstein, whose major interest prior to the laboratory's reconversion had been ballistic missile and antiballistic missile systems.

Each of them has his own reason for the shift, but the reasons seem to be cast in terms of relevance and academic balance, rather than in terms of any deep prejudice or feeling against the military.

"We felt," says Dr. Probstein, "what everyone else in America is feeling, although we felt it perhaps more strongly. We maybe sensed that there would be a shift from putting so much of our national resources into defense and space. We wanted to move on to problems that directly affect us."

Dr. Fay explains similarly. "I got to thinking," he says, "about the research I'd been involved in previously. It was evident that it hadn't affected my daily life or that of anyone I knew." Dr. Fay is now studying the effect of smokestack design on smoke dispersion into the atmosphere—"a pollution problem that affects our daily lives," as he expresses it.

Another impetus for the shift in emphasis, explains Dr. Probstein, was the realization that the laboratory was producing a steady supply of graduate students who had nowhere to go but the defense industry. "Almost all our graduate students who didn't go into university teaching wound up in the missile and aircraft industries," he says. "We were churning out defense-oriented graduate students."

Thus at the end of 1965 the professors decided to look around for problems relevant to everyday life to which they could apply their skill in fluid mechanics and chemical kinetics.

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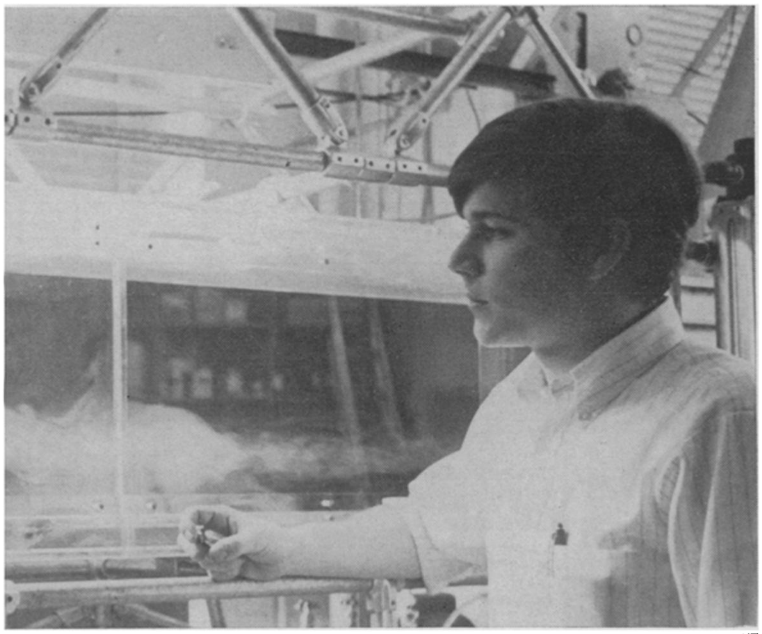
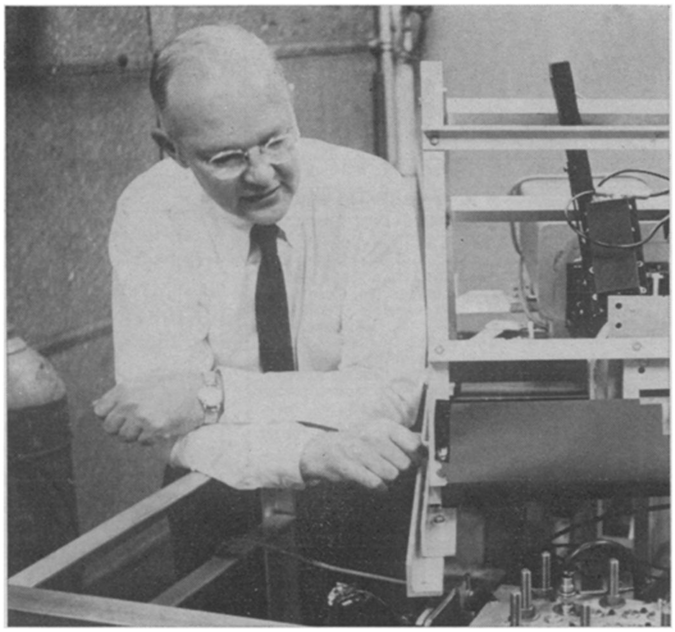




Photos: MIT

Grad student Thomas Hewitt studies smokestack design.

Dr. Keck: First, money; later, "a lot of satisfaction."

The researchers' decisions as to which new directions to pursue were largely individual. The first part of the venture was a study by Prof. Shapiro of a problem which obviously involves fluid mechanics: How an infection in the bladder can pass through the ureters to the kidneys, against the direction in which fluid flows. Application of fluid mechanical methods showed that the ureters contain a minor flow of fluid in the opposite direction. Learning what kind of valve controls this flow needs more experiment, particularly on sick people. Pursuing the biomedical theme, Prof. Shapiro is now studying how a weakened heart can be helped to open and close, again using fluid mechanical principles.

Dr. Probstein's new specialty is desalination of seawater. About the time the laboratory was deciding to change its emphasis, he was visiting Israel, where he was shown around a desalting plant. The plant, he says "was designed by 19th century engineering," and he decided to investigate from a fluid mechanical viewpoint whether it could be made more efficient. The process he has designed has proved so successful that Dr. Probstein is now negotiating a contract for a 200,000-gallon-per-day pilot plant.

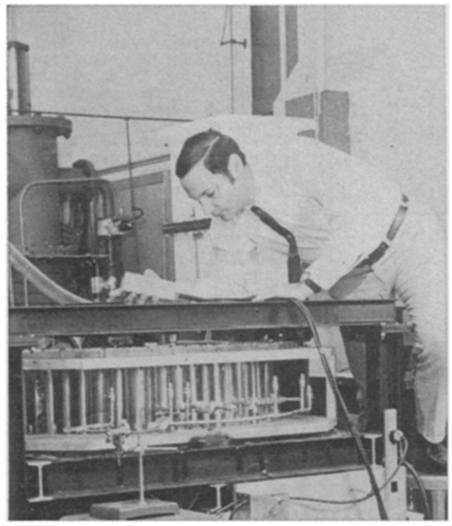
A month later, Dr. Fay happened to look at belching smokestacks as he was driving into work. He wondered why they were designed the way they were; investigation showed no logical reason, and the reentry expert decided to apply his skill to redesigning stacks to ensure minimum pollution of the atmosphere. He has succeeded in producing a laboratory model for the growth of a plume from a smokestack which compares very well with measurements of plumes from actual stacks and with fluid mechanical theory.

In another investigation, Prof. Keck has used spectroscopy to study for the first time how nitric oxide—an important but little understood pollutant—is produced in automobile engines during combustion.

These, of course, are the success stories of the reconversion, but there were a number of blind alleys. For example, Dr. Probstein started an investigation of astrophysical fluid dynamics which involved the motion of comets, and made some contribution to the field, but then dropped it as it was not really relevant to everyday life. Other ideas for topics were not taken on because either there were no critical problems involving fluid mechanics or the critical problems were already well taken care of by other methods.

"It was damned hard work to find the critical problems and areas where we could do something," says Dr. Probstein. Nevertheless, he adds, once they had arrived in their chosen new fields the opportunities for important contributions became more evident; in the pollution field, for example, the laboratory is now involved in water pollution, thermal pollution and some kinds of automobile combustion.

With the hurdle of choosing projects cleared, the next loomed up immediately. This was funding for the new ventures. The group faced three problems which served to turn them as much into fund-raisers as working scientists. First, explains Dr. Probstein, funds in socially oriented areas are very tight. Second, the means for funding university research in these areas are primitive as compared with the smooth Department of Defense procedures to which



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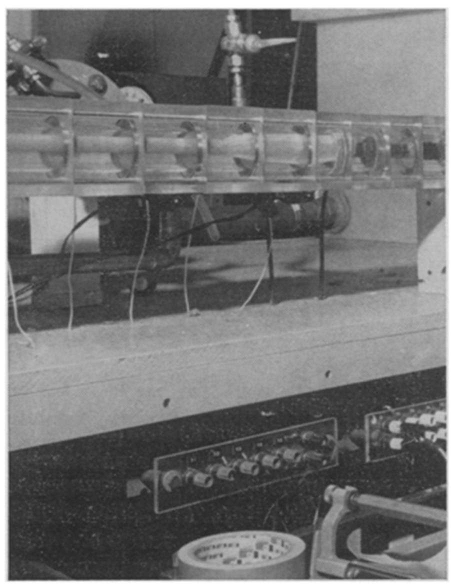

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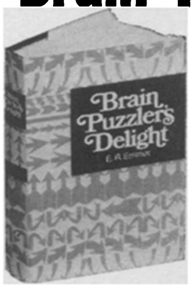

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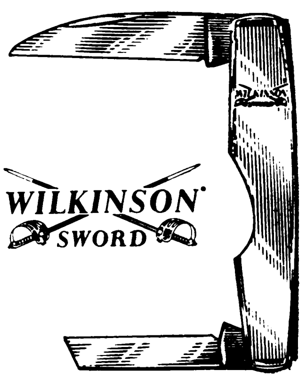

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the laboratory had become accustomed. And third, the group had no paper qualifications or experience in the new fields.

Indeed, money to further their social projects has been the greatest source of difficulty. "We've become very big proposal writers," comments Dr. Probstein wryly, adding that faculty searches for funding are keeping them from giving the attention to graduate students that they should.

The slow pace of funding is not all the result of treading unfamiliar paths. Federal agencies themselves are not always sure what to do with research proposals when they get them.

The MIT researchers are particularly irked at the Department of the Interior and the Public Health Service, which according to Dr. Fay appear at a loss when approached by a university group with new research ideas, and with the automobile industry, which they see as opposed to them at every turn. Indeed, Prof. Keck's study of combustion in automobiles and its relation to air pollution has been funded predominantly by MIT—outside funds have proved totally unavailable. And another proposal—to investigate the flow of oil on seawater by fluid mechanical means—met with little financial response before the oil slick incident off Santa Barbara in March of this year (SN:3/15, p. 258). The laboratory has developed, on paper, a bubble screen the scientists believe can be used to surround a spreading oil slick, but is stymied for funds to develop this idea.

Despite the financial worries, the laboratory has changed its balance over three years from 100 percent defense research to a ratio of 65 percent socially relevant work to 35 percent defense research. The group had aimed for a 50/50 mix, but Dr. Probstein comments that "we're very happy with what we got."

Graduate students entering the laboratory are so eager to work on the social problems that Dr. Probstein confesses to some difficulty in persuading students to try out the defense-related research. Graduates leaving the laboratory are going into well-paid, prestigious jobs in companies eager to move into the field of socially oriented research. "There's a feeling in this laboratory right now that we're doing something," comments Dr. Probstein.

Perhaps the feeling is best summed up by Dr. Keck, the converted nuclear physicist, who first moved into the social field because he belived there might be extra funding in it. "Now," he says, "I feel there's a lot of personal satisfaction in socially oriented problems—I've just learned to like them." ◇

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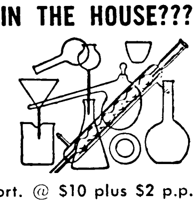

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