Science & Technology

Princeton's Gottlieb honored for 'impossible' fusion gains

by Vin Berg

Three generations of fusion scientists, and over 350 supporters of the U.S. fusion research program, gathered at a New York hotel banquet Feb. 6 to honor Dr. Melvin Gottlieb, the retiring head of the Princeton Plasma Physics Laboratory. All of the participants, nuclear industry representatives, fusion scientists, labor leaders, Department of Energy officials, International Atomic Energy Agency spokesmen, legislators, and corporate officials, had a political purpose in being there.

Dr. Gottlieb has spent 25 years in the fusion-research effort, from a time when almost everybody thought fusion energy an impossibility, through the last few years of stunning scientific breakthroughs, leaving no doubt that this power source of the stars can be harnessed by man. Under his leadership, the fusion program at Princeton achieved a 60 million degree temperature in a device called the tokamak—high enough to ignite fusion reactions, and much hotter than the sun.

By honoring Gottlieb, who Fusion Energy Foundation director Dr. Morris Levitt called "an authentic American hero," the assembly was making a kind of political announcement. No environmentalists, no media misinformation, and no budget cutters will be allowed to get in the way of fusion-energy development.

"This banquet is but a small part of what the Fusion Energy Foundation has done," said Dr. Gottlieb. The New York-based foundation, sponsor of the dinner, is only six years old, but already the largest nonprofessional scientific organization in the country with 15,000 members. "The FEF did a simply magnificent job providing support to get Congress to enact Mike McCormack's fusion-energy legislation. The FEF has provided real leadership in educating the public, Congress, and scientists in other disciplines about fusion."

Dr. Levitt asserted: "This banquet represents the kind of political muscle we need to ensure that we turn the mandate of the 1980 fusion legislation—a prototype fusion reactor by the year 2000—into a reality."

The banquet itself represented only a cross-section of the "political muscle" to which Dr. Levitt referred. At one point, he read more than a dozen telegrams of support from congressmen, senators, and others unable to attend. Former Rep. Mike McCormack, the initiator of the Magnetic Fusion Energy Engineering Act of 1980, which Dr. Gottlieb called "a turning point in history," wired the following message: "Even as you read this, we are entering upon a new struggle to obtain recognition of the importance of full funding for the program. Any suggestion that the federal budget be cut below $525 million for fiscal 1982 must be met with overwhelming pressure from all walks of American life, with the result that the administration and the Congress will acknowledge the broad base of public support for moving forward agressively with our magnetic fusion engineering and development program and with the political necessity of funding it at appropriate levels."

Why fusion?

Fusion energy results from fusing, rather than as in fission, splitting, the nuclei of atoms. Stars amount to large fusion reactors, colliding and fusing hydrogen atoms through gravitational force; scientists on earth use the implosive force of lasers or other high-power beams or magnetic fields to initiate the same process in the laboratory. Thanks to breakthroughs in heating and controlling plasmas, the hot gases in which fusion reactions occur, at Princeton and elsewhere, a fusion reactor can be put into operation within the next two decades—the goal of the McCormack bill.

What will that mean for energy? One gallon of ordinary water, fusion's fuel, can produce energy equivalent to 300 gallons of gasoline. The fusion process itself can be used to break materials down into their basic elements, which can be recombined to produce desired new materials. Obviously, the promise of fusion energy totally redefines mankind's future, and the current energy policy debate. No wonder that hundreds of people gathered to honor Dr. Gottlieb.

A sense of the long years of effort that brought us to the verge of the fusion era was given by Dr. Robert

Moon, an official of the Fusion Energy Foundation who was Dr. Gottlieb's college physics teacher at the University of Chicago. Moon related vignettes of Chicago's first cyclotron during the 1930s, when, lacking the $2000 to put the magnet together, the scientists constructed it by hand.

"The journals of that time were already lamenting that by the end of the century the U.S. would run out of liquid fuel and be wondering what to do about it," he reported. "Melvin Gottlieb has demonstrated that we're ready for fusion energy. . . . In heating a plasma to millions of degrees, he asked what it would do. . . . It set the world on fire, and gave us great hope."

Dr. William Ellis, head of the DOE's mirror-device research, emphasized Gottlieb's "work in the trenches," his "political will" to get the job done when fusion energy's promise was unrecognized, or being suppressed. Even at the time of Princeton's August 1978 temperature breakthrough, Dr. Gottlieb and his colleagues received praise from the international community, but had to contend with the derogatory statements of then Energy Secretary James R. Schlesinger, whose arguments for "energy conservation" lost even the semblance of credibility in light of fusion progress.

Fusion's future

Earlier than afternoon, Dr. Gottlieb was interviewed by the press at the FEF's New York offices. *New York Times* science editor Walter Sullivan asked: "How can the fusion program cut its budget? The space program—to use the Galileo Mission, for example—took one thing and dropped it to meet their 10 percent cut. Is the fusion program amenable to this sort of thing?"

Gottlieb said no. "You could decide to narrow the efforts. In my view, this would be extremely premature and would represent a diversion. One could say that the system that is furthest ahead, the tokamak, should be the focus—'let's put all our eggs in that basket.' But the tokamak is not ready to receive those eggs. We're not ready for such a step. It would be a serious error."

Alternatively, Dr. Gottlieb continued, "you could simply insert delay in the program. . . . One would do all the things already under way . . . but slower. That would also have a very serious effect on the program."

Any delay, he indicated, would result in a significant loss of scientific manpower. "We have many people, very good and well-trained people. I have seen this develop over the years. They are now fully engaged, and we have begun to engage industry as well. The people in industry have their own skills. But those skills must be, shall we say, fine-tuned. It takes a period of training before these people are indeed useful, as they now are. To disengage them at the present time would dissipate those efforts that have already been made. These trained people would move to other activities. They would no longer be available."

The physicist emphasized that now is the time for "the effort required to get into technology." "Certainly there are many things required for a successful fusion reactor. One among them is, of course, the physical aspect of being able to heat a gas to a high enough temperature and keep heat losses to a sufficiently low level. . . . But it alone doesn't build you a power reactor . . . to that must be added a great deal of work on the engineering and technological aspects . . . before you have a practical reactor. We are just getting into that phase," and can afford no funding cuts. "This is a field in which the technology and the science are so interdependent that they must be developed together."

"There are substantial improvements that can be made in the tokamak, many modifications that might in the end prove simpler, cheaper, or more reliable. And there are different approaches like the mirror, or hybrids between the two—for example, the Elmo Bumpy Torus, which is a sequence of mirrors arranged around a ring. These take time to work out. And unfortunately, this research is not cheap."

The *New York Times* editor asked him how he thought the fusion program would fare under the new Reagan administration. "When one looks for portents," Gottlieb replied, "the only thing I think one can say is that the administration has been speaking favorably about the importance of research and applied research. From that policy standpoint, one would expect a favorable view to emerge. Of course, the budget pressures are also working, in the opposite direction."

Can it be done?

One implicit question was: "Is fusion really possible?" Dr. Gottlieb summarized his own thought. "Ten or 15 years ago, fusion seemed almost impossible. We were frustrated. But then, everything started to work, probably because of better control of the technology at the same time that we got better control over the physical ideas.

"Now, I am sure that it is achievable. I can't tell you what the costs will be. . . . We have to get the costs down to where fusion will be competitive. Here, too, I have no doubt that it can be done, whereas in the past, I doubted it.

"The change I can only describe this way. Back in the beginning, the theorists were working in one place, the experimentalists in another place, and it almost seemed as if they weren't even speaking to each other. . . . Now, both are addressing the same points. . . . It's a solid science. Now, we can even talk about new ideas with confidence. . . . It is as different as day and night. That is the change of the last years. It made a great deal of difference in my life."