Pellet fusion's precarious position

The fuel is in the oceans. There is enough for a few billion years — longer than that humanity hardly needs to worry about. The process for getting energy out of it works. The process, called inertial confinement fusion, consists of igniting thermonuclear fusion in a mass of fuel (deuterium and tritium extracted from water) by crushing the fuel mass in an implosion generated by blasting the fuel from all sides with energetic beams of light or ions. The whole world saw inertial confinement fusion work spectacularly at Eniwetok atoll almost 30 years ago.

The problem now is mainly one of scale, according to various scientists in the field who were gathered at the Symposium on Inertial Confinement Fusion, Status of the World Effort, in San Francisco last week. For civilian power applications one wants not a bomb but a series of rapidly repeatable microexplosions, each with the power of a barrel of oil or a ton of TNT. Such microexplosions could be contained and managed. To go with contained microexplosions the technology needs a means for converting the energy released to electricity. The scientific and technological problems are not simple, but no one at the symposium was heard to claim they are insurmountable. In spite of all these favorable characteristics, the field is in trouble. The trouble is mainly financial, but a little bit psychological too.

Inertial confinement fusion experiments are expensive. Richard L. Schriever, director of the Office of Inertial Confinement Fusion of the U.S. Department of Energy, told the meeting that in about the last decade the United States has spent over a billion dollars on ICF. It is in the 1982 budget for $122.5 million, down from $141 million in 1981. Schriever calls this "a moderate reduction." He expects funding to continue at about these levels for a few years until experiments now under construction have been completed and run. In the light of those results a decision should be made around 1985 with regard to the future course of the program.

What that future course should be was suggested some time ago by John Nuckolls of the Lawrence Livermore National Laboratory, one of the senior people in the field. He recently told a meeting of the Plasma Physics Division of the American Physical Society that an "Apollo type" program should be mounted for fusion (including magnetic confinement as well as inertial confinement). He has since told Science News that he has had no success in persuading government officials. In fact, rumors keep circulating to the effect that the administration's true intention is to dismantle the civilian ICF program and leave only the military aspects.

Perhaps yet another cue is being taken from Great Britain, the ideological mother country of the U.S. administration. Great Britain was one of the pioneering countries in thermonuclear fusion research, the third to produce its own H-bomb. Geoffrey Manning, director of the Rutherford Laboratory, told the symposium that the United Kingdom has "no program" in ICF, in the sense of a concentrated effort toward ignition of fusion. There are a few studies of lasers and fuel pellet shapes that may give useful information to the rest of the world's efforts.

Foreseeing the difficulties of persuading any one nation to large amounts of funding, Nikolai G. Basov, director of the P. N. Lebedev Physical Institute in Moscow, proposed that the effort toward a break-even experiment (one that gets as much energy out as is put in to implode the fuel pellet) be an international project. Basov figures (and others agree) that the laser for such an experiment would have to have several megajoules of energy. Even if the cost of lasers can be brought down to 100 rubles per joule, he says, that is still an item of several hundred million rubles. It is also several hundred million dollars, maybe half of all the United States has spent so far on civilian ICF. Chiyoe Yamanaka, director of the Institute of Laser Engineering at Osaka University, who reviewed the extensive Japanese program, seconded Basov's suggestion.

But Basov's suggestion raises a psychological difficulty. ICF began under military auspices as a way of studying the behavior of fusion fuel conveniently in a laboratory (rather than in an explosion). With the ban on testing it became the only available way. A little over a decade ago, ICF came out of the closet and acknowledged that it might have applications to civilian energy problems. In that time the military has been very sticky about how much it would let go public, and it has hovered nervously in the background ready to slam the door again if it felt threatened. Would the world's military establishments agree to the sharing of secrets necessary for an international program in ICF?

Robert Dautray, who is scientific director for the French Commissariat for Atomic Energy at the Center for Studies at Limeil, has a countersuggestion. He thinks the military should sponsor the civilian ICF program. He points out that military sponsorship has produced a number of things that became useful in the civilian economy. Pressurized water reactors, he relates, were developed for use in submarines. In France they are now used in a number of civil power plants, and the French find them more satisfactory than other fission reactor designs. Yet, were it not for submarines, pressurized water reactors would not have been developed.

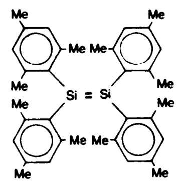
Similarly Dautray thinks the military could carry the civilian applications of ICF along with their own program. "Fusion needs a champion. Military backing is such a champion," he concludes.

—D. E. Thomsen

Silicon-silicon does a double take

Forms of life based on silicon long have been the stuff of science fiction. While that idea still is nothing more than fancy, the choice of element always has been a good one: Silicon behaves much like carbon, the elemental basis of life as we know it. Now, three chemists have "realized that silicon is a lot *more* like carbon than people think." Robert West and Mark J. Fink of the University of Wisconsin at Madison and Josef Michl of the University of Utah at Salt Lake City have synthesized and isolated tetramesityldisilene—the first known stable compound that contains a silicon-silicon double bond (Si=Si).

Organic chemistry owes its diversity partly to the fact that carbon readily forms a covalent double bond with another carbon or with other elements. Silicon chemistry, on the other hand, has been limited by the lack of analogous bonds, "despite numerous attempts to synthesize them over the past six decades," West and colleagues report in the Dec. 18 Science. But earlier this year—in a February Chemical Communications—A. G. Brook and co-workers of the University of Toronto reported the first stable Si=C-containing compound. And now West and associates have isolated the Si=Si-containing tetramesityldisilene—a compound that is stable at room temperature in the absence of air and that melts without decomposition at 178°C (342°F).



Tetramesityldisilene
(Me = CH_3)

West, et al./SCIENCE

"It's as if we've been playing silicon chemistry with alphabet blocks and we've been missing the letter 'C' [the ability that carbon has to form multiple bonds] for all these years," West explains. "Now that we've discovered it, we can make new words, sentences and paragraphs," he says.

What those new chemical words, sentences and paragraphs will be is still unclear. "The trouble is we've had these things [silicon-silicon double bonds] for such a short time that we really don't know what we'll be able to do with them," West says, "but we certainly think this will lead to a whole new area of silicon chemistry."

—L. Garmon