those here reported. In this work one finds also a kinetic analysis of admixture, which provides ball-park estimates of rates of growth, migration, and "acculturation" (hunter-gatherers entering the farmers' pool) compatible with observations.

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NEWS AND COMMENT

Report of Fusion Breakthrough Proves to Be a Media Event

On the weekend of 12 and 13 August, the unlikely subject of fusion suddenly became the leading news story in the country.

"Scientists at Princeton University have produced a controlled thermonuclear fusion reaction that experts are hailing as a major technical breakthrough," said the Knight-Ridder wire service in a story that was carried by 50 to 100 newspapers. "U.S. Makes Major Advance in Nuclear Fusion," was the banner headline of the Washington *Post*'s leading front-page story on Sunday morning. Radio and TV stations throughout the weekend reported the story with all the urgency of an international crisis, and by the end of the 2-day media blitz, many citizens apparently got the impression that after years of waiting for proof, fusion had finally been achieved. The message was so strong and so positive that it seemed—for 48 hours at least—that the energy crisis was over, solar energy and nuclear power were no longer needed, and that the future would be assured through fusion.

The heady optimism did not last long. By Monday afternoon, the Department of Energy, which had sponsored the Princeton research, was saying that no breakthrough had occurred, and that the results, while "gratifying," would make no change in the timetable or the funding for government fusion research, which is expected to require at least 50 more years to bear fruition. John Deutch, of the Department of Energy, said that the Princeton result came "sooner and in stronger form than we anticipated," but he characterized it only as "an item that bears on the first step" of a lengthy, costly, technically demanding development process.

One of the principal reasons for confusion was that the reports of the weekend had seemed to indicate that fusion had reached the long-awaited goal of energy breakeven—the point where a reacting fusion plasma produces more energy than it consumes. But the head of the Princeton laboratory, Melvin Gottlieb, said that the experiment in question had not made breakeven. However, he told a Washington press conference on Monday afternoon, 14 August, that "we're on schedule and I'm confident we will achieve breakeven" with a larger experiment due to begin operation in the 1980's.

What actually happened at Princeton that garnered so much attention? It was the dramatic conclusion of a sometimes discouraging experiment with a 3-meter diameter doughnut-shaped device called a tokamak, which can serve as a type of "magnetic bottle" for containing fusion reactions. The device, named the Princeton Large Torus, ran into severe engineering difficulties soon after it was built in 1976, but by spring of this year it was working well and by summer it was producing the highest temperature ever recorded for a tokamak. That temperature, according to Harold Eubank who conducted the experiment along with Walter Stodiek, was 50 to 55 million degrees Celsius, about six times higher than the temperature in the fusion experiment that had come closest to breakeven, one carried out with the Alcator tokamak at MIT in 1976. In order to get such a high temperature, however, Eubank and Stodiek had to lower the density of the plasma in their experiment. Temperature, density, and the length of time the plasma is contained are all important in magnetic fusion experiments and must simultaneously meet certain criteria for a self-sustained reaction to be achieved. Although the temperature was six times higher than MIT's, the combined measure of density and confinement time (which was 15 thousandths of a second) gave a value, Eubank told *Science*, which was 30 times worse than that attained in the MIT experiment. These results were obtained in July.

The significance of the Princeton result was not that it came close to breakeven, because MIT had improved somewhat on its 1976 result and still held the nearness-to-breakeven record. Rather, it was that in reaching such a high temperature the Princeton experiment had entered a plasma regime where wild fluctuations, called "trapped ion instabilities," were expected to degrade the confinement properties of a tokamak. These fluctuations had been earmarked by many in the fusion program as the biggest unresolved physics question that stood in the way of the development of tokamaks, which have been the leading candidates among various types of magnetic bottles since soon after they were invented in Russia in 1968. No evidence of the predicted fluctuations was found.

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Thus there was rejoicing at Princeton, and the news was quickly conveyed to Washington where the Department of Energy's fusion program has had to live with level or slightly decreasing budgets (in constant dollars) in the past 2 years.

The news spread quickly within the fusion community, but it took 2 weeks more to make national headlines. By 31 July, the nuclear trade press was reporting a big breakthrough at Princeton due to be announced in mid-August. The early part of August was also the time when the various program officials, in charge of solar, nuclear, fossil, and fusion research, were sending their fiscal 1980 budgets to the highest levels of the energy department for review.

By Friday 11 August, many science reporters knew something had happened at Princeton, but those who called the Department of Energy's press office were asked to wait through the weekend. That evening, a reporter for the Knight-Ridder newspapers heard of it, and put out the first story. The reporter, Dave Hess, says he could not confirm it until an unnamed official of the energy department's fusion office "very reluctantly" substantiated the reports. The Miami *Herald* published Hess's story on Saturday morning, and the Associated Press wire service, which had a considerably larger list of subscribers than Knight-Ridder, carried a bulletin based on the Miami *Herald* story.

A number of radio stations reported breakthroughs in fusion during the day Saturday, and by 3 p.m. a political reporter for the Washington *Post*, who happened to have weekend duty, found out about it. Bill Peterson says that the Department of Energy's Public Relations Office told him that industry sources had been trying to promote the story for weeks, and that scientists at Princeton said they were under embargo not to talk until the department okayed it. Peterson says that he was stuck until he thumbed through some literature that members of the Fusion Energy Foundation, an obscure and well-financed group that is allied with the U.S. Labor Party, had left behind after visiting him a couple of weeks earlier. In it, he found the name of Stephen O. Dean, the head of magnetic confinement systems and the architect of the fusion program's 20-year development plan. Dean, Peterson says, seemed angry with the embargo and "blew the story." Peterson quoted Dean extensively, and reported the achievement of the high temperatures for the first time.

Sunday morning, the story was on the front page, not only in Washington but also in Philadelphia and Detroit and other large cities. The whole weekend had been a slow one for national news, and fusion got full play. By nighttime, it was on the network TV news, where an unnamed Department of Energy spokesman was quoted as cautioning about big announcements at budget time. Early Monday morning, there was still so much unqualified optimism in the media that Department of Energy press spokesman, Jim Bishop, issued a bulletin cautioning that the Princeton work was only a "significant development." At the long-rumored press conference, finally scheduled on Monday afternoon, both Deutch, from the Department of Energy, and Gottlieb, from Princeton, said that some reports had been overblown.

Difficult Problems Remain

Deutch emphasized the difficulty of the technical problems that remain for fusion, and when asked if this would justify more spending replied that "reports like this are exactly what we need to defend the budget we've got."

Gottlieb emphasized the international cooperation in fusion research, the enthusiasm of the scientists at Princeton, and the superiority of the hardware in Princeton's tokamak over a similar-sized device in the Soviet Union.

After the press conference, most news media carried one final story on fusion and turned back to other matters—the upcoming summit conference, James Earl Ray's appearance on Capitol Hill, and the merits of allegedly noncarcinogenic cigarettes.

What did the Princeton result really mean? Opinions were divided on this subject. According to John Clarke, the deputy director of the fusion program, it modeled a fusion reactor for the first time. "No other experiment has produced a set of conditions in which all the processes we are aware of were present and showed scaling to a reactor of a practically small size," he said, noting that the scaling indicated that a tokamak reactor would have a diameter of 6 to 9 meters. (Scaling is the measurement of how much closer experiments come to a self-sustaining fusion reaction with each doubling of the size of the tokamaks.) "This doesn't stand by itself," he said, "but it is the most significant result we've had in fusion to date."

The head of the laboratory which conducts research on the leading alternative to the tokamak, Ken Fowler at the Lawrence Livermore Laboratory, was equally sanguine. "These are just the results we've been waiting for," he said. Though Fowler is developing a device called a mirror containment system, he said, "If I were developing tokamaks, I'd be knocking on people's doors right now."

Others were skeptical. One highly regarded university physicist observed that "It is fine that they haven't found a roadblock, but to infer that the road is now clear to a reactor is a bit of a jump." He emphasized, however, that even though he was a plasma physicist, he wasn't familiar enough with the status of tokamak theory to give an informed opinion. Tokamak theory, it seems, is such an esoteric science in which opinions range widely that only a few people really keep up with it. (Harold Eubank declined to comment on the theoretical implications of his experiment for this reason.)

The results of an informal survey by *Science* of highly recommended tokamak theoreticians were also varied. Bruno Coppi, who developed the Alcator at MIT, says that in his opinion the "trapped ion" problems that were singled out may have been given undue attention, and that other problems also based in tokamak theory may be more significant. Jim Callen, head of the theory section of the Oak Ridge National Laboratory, says that until more data from Princeton are analyzed "it is not totally clear" that the experiment has gotten into the proper regime to test the trapped ion problem. "It's not killing us, but it is not quite sure that it should have—the experiment is on the margin," he says. Ed Freeman, at Princeton, has no such reservations. "As far as we can determine, the ions are well into the trapped ion regime and we see no evidence of deterioration of the confinement," he told *Science*. Freeman agreed with Coppi's observation, however, that other instabilities can be predicted. John Dawson, at the University of California at Los Angeles, says that the trapped ion problem was a cloud that has dissipated. "One could make up scenarios of other things that could get you, but I think things look considerably brighter."

Can one be confident that the present good behavior of plasmas will prevail all the way to a reactor? "Total confidence comes only after one has achieved the results in a burning plasma," says Dawson, and "I don't think they've quite done that yet." All four plasma theorists agreed that no one understands yet why tokamaks scale as they have in the last several experiments and that the matter needs a great deal of work. Freeman and Dawson think the scaling properties observed so far will probably persist in a reactor, while Callen thinks it is some-

what premature to project to the 1980's tokamak, and even more premature for a reactor. The plasma theorist who is the undisputed dean of tokamak studies, Marshall Rosenbluth of the Institute for Advanced Studies, could not be reached for comment, but his office noted that he had been called by President Carter recently, so presumably the White House has tallied his vote on the subject. (Scaling is one of the most critical factors in projecting the economics of fusion power.)

So the matter of the significance comes to an uneasy conclusion. There is no doubt among physicists that the Princeton results are salutory, but the experts' opinions on the meaning are varied and in part conflicting. There is no consensus that the finding clears the way to fusion. Most observers think that the good news heard last week will carry through to the 1980's experiment, but whether it will apply to a full-sized fusion reactor they are not so sure. Some experts do not appear to know what to make of the results yet and all agree that it does not guarantee scientific proof of fusion, much less successful engineering of a fusion reactor. (Among six critical problems for tokamaks identified in a recent review of fusion compiled by John Deutch's office, the Princeton result only addresses part of the first one.)

Now that it is over, people can resume reading their solar energy catalogs again, continue with plans to insulate their houses, and put aside a little longer the dream of cheap energy. It may not have been the last word on fusion, but it sure was a good story.

—WILLIAM D. METZ

Senators Hear Case for Psychotherapy

The Senate Finance Committee held an unusual morning of hearings last week devoted to coverage of mental health services by Medicare and Medicaid.

The fact of the hearing may be evidence that Congress is preparing to respond to mounting pressure by the mental health professions—bolstered by accumulating evidence on the economic benefits of making mental health services widely accessible—by expanding mental health coverage, particularly under Medicare. This crusade—and that is what it is beginning to look like—is particularly significant because it is an attempt to lay a basis for future coverage under national health insurance.

At the hearings, presided over by health subcommittee chairman Herman Talmadge (D–Ga.), senators heard testimony from psychiatrists, psychologists, psychiatric nurses, Community Mental Health Center representatives, and Martin L. Gross, author of the controversial book *The Psychological Society*.

Gross was the only antipsychotherapy person in the lot. Psychotherapy, which he branded "an absolute hoax," is "considered a reasonable practice in only one country in the civilized world—the United States," he claimed. Contending that his views were endorsed by such prominent biochemical researchers as Seymour Kety and Solomon Snyder, he made a big pitch for more biological research and better treatment for the major mental illnesses. He claimed that studies showed psychotherapy to be worthless for those with nonpsychotic problems, which he dismissed as the normal anxieties all humans are heir to. He also asserted that a person's "natural temperament" exists at birth and "parents have very little to do with the emotional balance of children."

With enemies such as this, psychotherapy hardly needs friends. The senators present were clearly more sympathetic with the views of the mental health professionals.

Most of the talk was about the need to expand coverage under Medicare. The provisions for mental health have not been changed since 1965, when the act was passed. In what professionals, backed up by the President's Commission on Mental Health, regard as gross discrimination against mental as opposed to physical disorders, Medicare sets a lifetime limit of 190 days for hospitalization (physical disorders are allowed 90 days per episode); there is a $250 annual limit on payments for outpatient visits, and only 50 percent of the cost per visit is reimbursed (as opposed to 80 percent for physical illness).

Medicare was passed when there still were few data on the cost-effectiveness of including outpatient psychological services in health systems. But witnesses cited a half-dozen studies which they said show that availability of mental health services significantly reduce the number of visits people make to the doctor, as well as hospitalizations.

Perhaps the most extensively studied system has been the Kaiser-Permanente Health Plan in San Francisco, where the effects of short- and long-term psychotherapy have been followed for 18 years. Kaiser-Permanente psychologist Nicholas Cummings, who is president-elect of the American Psychological Association, said that a 5-year study of a group of patients who had short-term psychotherapy showed a "sustained reduction" in the use of medical services of 60 to 70 percent. This provides support for the frequently made claim that over half of visits to doctors are spurred primarily by psychological problems.

Also cited was a 4-year study of people over 65 in Harris County, Texas. According to psychiatrist James L. Cavanaugh of Rush-Presbyterian-St. Luke's Medical Center, access to treatment for mental illness reduced the mean length of hospital stays from 111 to 53 days—resulting in a saving of $1.1 million.

Medicare was criticized more than once for being "penny wise and pound foolish": the limited benefits for outpatient services force old people into mental hospitals and nursing homes; yet many who are diagnosed with the catch-all term "senility" suffer a variety of conditions that could be reversed without hospitalization.

Although mental health professionals are united on general principles, there has been a major and at times bitter conflict between psychiatrists and non–medically trained professionals over who should qualify for direct reimbursement under various insurance schemes. The psychiatrists emphasize their "unique role" in encompassing medical and psychological expertise. They see themselves at the top of the mental health pyramid and as necessary intermediaries between psychologists, psychiatric nurses, social workers, and patients to ensure accountability and quality control.

Psychologists, however, see themselves as alternatives rather than as sub-

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