1990 for cold fusion research. Only a few weeks before, Walker was more restrained, convincing members of the energy research and development subcommittee to shift just $5 million from hot fusion R&D into cold fusion.

But Utah's fund-raising drive may be derailed by the failure of many other laboratories to reproduce the results and by growing skepticism among physicists (see box). In particular, they have been unable to produce the heat that Pons and Fleischmann claim to be generating in their jars containing heavy water and palladium electrodes (*Science*, 28 April, p. 420). Thus, scientists from other fusion labs who testified before the committee urged members to wait for firm verification before throwing large sums of money at cold fusion.

"The experimental evidence that has been laid on the table simply is not adequate to be persuasive," said Harold Furth, the Princeton Plasma Physics Laboratory physicist who took on Pons in front of 7000 chemists only a couple of weeks ago during the American Chemical Society's spring meeting in Dallas. Ronald G. Ballinger of the Massachusetts Institute of Technology's (MIT) Department of Nuclear Energy was more restrained: "There needs to be a technical, scientific confirmation of results before you make a big commitment of funds."

Steven E. Jones, who has been working on cold fusion at Brigham Young University, told the committee that "cold nuclear fusion does not offer a short cut to fusion energy. It is just another door." He said it would be unwise to sharply cut back the mainstream hot fusion programs, which are based on tokamak reactors and laser-driven compression. At this point, Jones says, these programs "currently represent the best road to achieving controlled nuclear fusion."

Fleischmann readily concedes that the Utah heat-producing discovery, which appears to result from the fusion of densely packed deuterium within the lattice of a palladium electrode, is not sufficiently developed to produce steam to drive a turbine generator. This "will require a special effort in technology"—one that could cost $1 to $10 million just to demonstrate the feasibility on a small scale, he says.

While Fleischmann urged the science committee to move aggressively on funding cold fusion research, some members questioned whether this was absolutely necessary. Representative Marilyn Lloyd (D–TN) asked Pons whether he was really sure that his invention was real. In response, he said that "for 5½ years I think we have been our most severe critics on that. . . . We have felt sure for 2 or 3 years."

Pons revealed that 19 new fusion experiments are getting under way now at his Utah laboratory. A Los Alamos National Laboratory (LANL) team led by fusion researcher Rulon Linford is expected to participate in one of those experiments. Initially, LANL will send a few investigators to Pons's laboratory and later the test cell Pons is providing LANL will be transported to Los Alamos for more extensive studies. This should enable the national laboratory to confirm their results, Pons said.

In an attempt to quickly assess the true merits of Pons and Fleischmann's experiment, Energy Secretary James Watkins on 19 April asked the national laboratories to step up their research efforts. Watkins wants them to complete an initial assessment of the phenomenon within 90 days.

The reason why federal laboratories have not produced any excess heat in dozens of experiments so far is because of improper fabrication of palladium electrodes, claims Robert Huggins of Stanford University's Department of Materials Science and Engineering. Huggins and researchers at Texas A&M University continue to report positive heat production in their respective experiments.

Daniel L. Decker, chairman of Brigham Young's physics department, says the best thing scientists can do now is "go back to their laboratories and do some experiments instead of giving speeches." The problem facing Pons and Fleischmann however, is that many of those who have gone back to their laboratories have come up dry, and they are now offering alternative explanations for the Utah effect.

■ MARK CRAWFORD

Cold Water from Caltech

"We're suffering from the incompetence and delusions of Professors Pons and Fleischmann," said California Institute of Technology theoretical physicist Steven E. Koonin, mincing no words as he addressed a crowded special session on cold fusion held at the Baltimore meeting of the American Physical Society (APS) on the evening of 1 May. "The experiment is just wrong."

Indeed, the credibility of the cold nuclear fusion results touted so vigorously by chemists Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton in the United Kingdom has been dealt a serious blow by Caltech. After replicating Pons and Fleischmann's fusion-in-a-test-tube apparatus as best they could, a 17-member team of chemists and physicists found many sources of potential error, and concluded that all the evidence for fusion can be explained by conventional processes.

Details of the Caltech experiments were presented to the meeting by electrochemist Nathan Lewis, who is co-leader of the team along with physicist Charles Barnes. Like Pons and Fleischmann, he said, they used palladium electrodes to electrolyze heavy water, deuterium oxide. The assertion is that the liberated deuterium will be concentrated in the palladium metal and will eventually begin to fuse. That assertion rests largely on Pons and Fleischmann's claim that four to ten times as much energy comes out of their electrolytic cell as goes in, but the Caltech researchers showed that such energy balance measurements depend critically upon where the thermometer is placed in the cell and upon how well stirred the electrolyte is. "We asked Pons if he stirred," says Lewis. "No answer."

Another claim is that fusion in the electrode produces helium-4, instead of the helium-3 or tritium expected from conventional deuterium-deuterium fusion. This suggests that cold fusion involves some fundamentally new physics. And yet, says Lewis, the published results show no indication that Pons and Fleischmann checked for contamination from helium-4 in the air. "Pons refused to answer any of our inquiries" on the subject, said Lewis.

And so it went. No neutrons could be found. No tritium could be found. And Utah's raw gamma-ray data seem consistent with background from radon. "We see no evidence whatsoever for nuclear reactions or even for unusual chemical reactions," concluded Lewis.

Conspicuously absent from the APS meeting were Pons and Fleischmann themselves. Session organizers explained that they had been invited, but had declined on the grounds that they were too busy preparing for their appearance before Congress (page 522). As *Science* went to press they had not returned telephone calls; a university spokeswomen said that they had both asked not to be disturbed while they prepare new data for the Electrochemical Society meeting in Los Angeles on 8 May.

■ M. MITCHELL WALDROP