sit down and discuss how to generate the two things they all need: money and political clout."

Brenner of the U.K. Medical Research Council, who is one of the main architects of Britain's recently announced genome program (*Science*, 31 March 1989, p. 1657) and a skeptic of Watson's scheme, is keen that there should remain some form of central coordination and direction. "Somehow we will have to have at least one hub—perhaps three to cover the whole of the world—with the spokes going out to individual laboratories and research groups," he says. One function of such a hub, adds Walter Gilbert of Harvard University, would be quality control.

Gilbert endorses the idea that much of the work should be done on a networked basis. "At the moment, the way that groups are developing the technology in this country and abroad makes it possible to think of breaking up [the mapping and sequencing project] into different chromosomes," he says.

Watson seems keen to play down claims that the United States should exert a strong leadership role in an international sequencing effort, perhaps aware that this could dissuade some countries, such as France, from endorsing the active participation of their scientists. "The thought that we can dominate the genome initiative strikes me as totally unrealistic, and it is also unrealistic to say that there will just be one hub," he says. "It is a perfect program for international cooperation and by having other countries coming in, we can substantially reduce the costs to the U.S."

Given the "tricky question" of how deeply Japanese scientists should be involved, Watson says that the optimal solution might be a judicious mix of collaboration and competition. "Perhaps everyone should be allowed to compete on one chromosome, and we could use this as a test bed for comparing the jungle to the civil approach," he suggests.

Victor McKusick, the president of HUGO, says many of the organization's 220 members are sympathetic to the idea that individual research centers should assume responsibility for bringing together and completing information from other laboratories on particular chromosomes—providing that the choice of such lead centers comes from within the scientific community. However, he emphasizes that "there has not been any policy decision taken yet."

But Watson admits that he is really just raising a trial balloon. "This idea of nations each taking responsibility for chromosomes is something to throw out and see if we can put together in some way," he says.

■ DAVID DICKSON

Wide World

Show and tell. *Martin Fleischmann demonstrating the Utah experiment to Marilyn Lloyd, chairwoman of the subcommittee that authorizes funds for energy research.*

Utah Looks to Congress for Cold Fusion Cash

But even help from a Washington lobbying firm may not be enough to overcome negative results from other labs

THE RUSTY STAND bearing a small glass jar with tubes protruding from its cap made for an unlikely exhibit in the halls of Congress. But there it was: the by-now world famous apparatus employed by the gurus of cold fusion, Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton in the United Kingdom, who were in Washington to tell their story to legislators.

The appearance of the two electrochemists before the House Science, Space, and Technology Committee on 26 April was more than just a replay of the roadshow the duo has staged for various groups in recent weeks. This time an entourage of officials from the University of Utah were in tow and they were shopping for $25 to $40 million to help create a $100-million Center for Cold Fusion Research in Utah.

To help orchestrate this effort, the university has enlisted the services of Cassidy & Associates, the Washington lobbying firm renowned—or notorious, depending on your point of view—for helping universities secure funds directly from Congress for projects that often have not passed through the usual peer-review process. The firm arranged private meetings with members of Congress; set up interviews with the *Washington Post* and the *New York Times*; and the firm's founder, Gerald S. J. Cassidy, sat alongside university officials at the hearing.

Chase Petersen, the president of the University of Utah, also brought along an unpaid Boston consultant to whip up concern about international competition. "I am here because I am concerned about my three children and the future prosperity of their generation in America," Ira C. Magaziner, president of Telesis, Inc., told legislators. His message was simple—that the Europeans, Japanese, and Koreans will steal America's latest invention, cold fusion, unless the federal government embarks on a crash program to understand the phenomenon and develop marketable technologies.

At least one committee member, Robert S. Walker (R–PA), the ranking Republican, seems receptive to the university's overtures. Walker advised his colleagues at the hearing that "$25 million might be a more realistic" down payment for Congress to provide in

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