

sentatives George E. Brown Jr, a California Democrat, and Robert Walker, a Pennsylvania Republican—respectively chairman and senior minority member of the Committee on Science, Space and Technology—introduced an amendment that would require the President to certify by 1 June 1993 that at least \$650 million in foreign contributions for

the SSC were safely in the US Treasury. That sum equals about one-third of the \$1.7 billion that Congress expects will go toward the super collider from foreign governments. Although the House approved the Brown-Walker amendment, it was made moot by the subsequent vote to jettison the SSC project.

The House decision is apt to bring

on an unrealistic outcome: In terminating the SSC, DOE would receive a total of \$34 million to close out the project and pay off some 19 000 contractors, or it may use the appropriation to supplement the budgets of other high-energy physics programs, such as Fermilab's main-injector upgrade or SLAC's proposed B factory.

—IRWIN GOODWIN

A DOE PANEL THINKS THE UNTHINKABLE: BUDGET SQUEEZE COULD ELIMINATE SLAC

The good times may have stopped rolling for high-energy physics. Not only is the Superconducting Super Collider in grave trouble politically and financially, but the US high-energy community itself is brandishing signs that there may be one or two labs too many for these hard times.

Since its first meeting in 1967, the High Energy Physics Advisory Panel has always recommended building larger new facilities for particle physics and has seldom proposed shutting any. But in an era when the Department of Energy's physics budgets are almost certain to be flat or worse for the next few years, the agency's leaders and some particle physicists have decided that they just cannot afford everything on HEPAP's wish list. This was exactly what Energy Secretary James D. Watkins said bluntly last fall to the HEPAP task force led by Charles H. Townes of the University of California at Berkeley. In the course of his statements to the Townes group, Watkins posed an unnerving question: If DOE funding for the high-energy physics program for fiscal 1993 had to be chopped savagely, by as much as 10% before inflation, what should happen? The answer from the task force was unexpectedly brutal: Should push come to shove, the SSC continues to be the highest priority and should be completed in 1999, no matter what the cost or pain to the rest of the community. Second to the SSC, the Townes group recommended upgrading Fermilab's Tevatron.

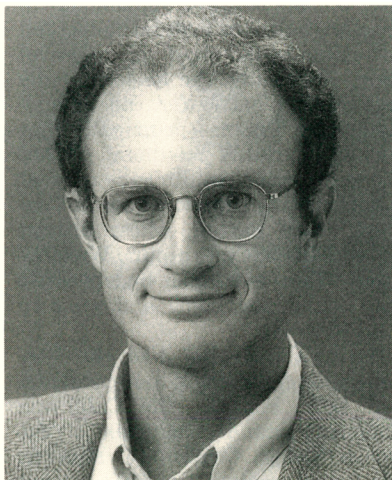
In 1990, a HEPAP subpanel headed by Frank Sciulli of Columbia University "strongly" endorsed building an electron-positron "B factory" with asymmetric rings, for which SLAC and Cornell have issued competing plans. The Sciulli subpanel ranked the project third on its priority list after the SSC and the Tevatron main-injector upgrade (PHYSICS TODAY, December 1990, page 20). One year later, confronted by DOE demands to

fit the high-energy physics program to a sharply pared-down research budget, the Townes subpanel reluctantly concluded that neither the \$204 million Tevatron upgrade nor the \$184 million B factory at SLAC should proceed (PHYSICS TODAY, December 1991, page 53). In addition, the Townes subpanel found that the worst-case scenario would most likely reduce the 1993 operating budgets for Fermilab by 9%, Brookhaven by 13%, and SLAC, Argonne, Brookhaven and Lawrence Berkeley by some 12% if the SSC is to go forward with flat funding. Under this budget model, even university research would suffer reductions of about 6%.

Accompanying a copy of the Townes report to DOE officials last November was a letter from HEPAP Chairman Stanley Wojcicki, of Stanford University, addressed to William Happer, the department's director of energy research. Wojcicki's letter appeared uncommonly bitter: "It is no exaggeration to say that the recently concluded HEPAP meeting... was by far the most depressing one in my memory. Being asked to respond to such drastic budgetary cuts gave us

all a feeling that we were being asked to advise DOE on how to implement the demise of high-energy physics research in the US. The budget reduction will undoubtedly cause severe and long-lasting damage to the compelling and balanced program of research investigations in particle physics under way now. Moreover, this new apparent policy seems to us to be especially unwise because the nation is simultaneously investing heavily in... the SSC. We are very concerned that reductions in the breadth and personnel of the high-energy physics base program at this time will inevitably undermine our ability to exploit [the SSC] when it turns on in eight years... It makes very little scientific or economic sense to maim the existing high-energy physics program and even less sense to do so at a time when everything should be done to ensure the smooth transition of the present activities to the SSC era... We are distressed because, if the contemplated scenario does indeed occur, then many exciting physics opportunities will have to be postponed, significantly reduced or, most often, simply thrown away."

Among the "grave consequences" likely to follow the proposed Draconian actions, Wojcicki foresaw "no way to 'balance the budget' without turning off, phasing out or seriously curtailing" high-energy physics conducted at US universities. "We are concerned that we may not be able to live up to the current expectations for our future participation in international collaborations," he asserted. Equally painful, Wojcicki lamented, would be the effect on "perhaps hundreds of people [who] will have to be laid off at the national labs [and on] graduate students, postdocs and assistant professors [who] will be forced out of the field. Senior faculty will have to decide whether they can responsibly encourage young people to join the field. Young people will find it hard to commit to a field which has difficulty



Witherell: Advising in hard times.

maintaining its promises."

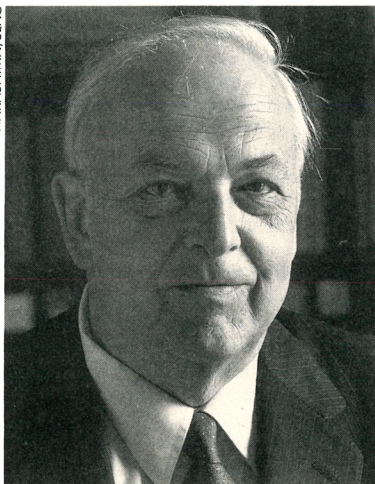
Nary a week passed after the Townes report was issued before members of HEPAP and the Townes subpanel began hearing complaints and catcalls from particle physicists at universities and national labs. In fact, Wojcicki noted later, most of the letters and e-mail from particle physicists, especially from younger people, "expressed anger, dismay and disappointment."

The response simply highlighted the lack of consensus within HEPAP as to the exact nature of the advice to be given to Watkins and Happer. Summarizing HEPAP's sometimes contentious discussions, Wojcicki observed that members disagreed with the Townes subpanel and unanimously endorsed upgrading Fermilab's main injector to augment the luminosity and intensity of the Tevatron proton-antiproton collider in the effort to discover the top quark and ascertain its properties with certainty. Still, HEPAP was divided on how to improve the main injector without diverting funds from programs at the other labs or at universities. Wojcicki stated that the panelists had argued for maximizing the chances of upgrading the Tevatron but could not agree on how to fund the project. Even so, Wojcicki wrote to Happer, the majority of the Townes task force conceded that the decision to proceed could be reached only after a careful study of the "out-years"—that is, the period during construction. Thus, stumped by DOE's financial dilemma, Wojcicki urged Happer to ask HEPAP to appoint still another subpanel to recommend an optimum program in high-energy physics for the fiscal 1994–97 period, focusing not only on the Tevatron injector upgrade and B factory physics but on a funding profile for the entire core program in the years before the SSC would be running.

Seeking a third opinion

The ruckus kicked up by the Townes report and DOE's own budget crunch sent Happer scurrying to carry out Wojcicki's call for a third opinion. In December, Happer asked HEPAP to set up a subpanel to examine the future of high-energy physics, with special emphasis on the mix of university-housed research and DOE-based accelerators, and to reach a conclusion on whether to initiate any new facilities or to improve any older one during the next five years. What's more, after Watkins and Happer took notice of the uproar they had caused in the community by asking the Townes subpanel to consider the situation in the light of a 10% budget cut,

NAKASHIMA/SLAC



Richter: Awaiting word to go ahead.

they backed off somewhat and proposed that the new subpanel use less stringent budget guidelines. Even so, the budget scenarios left little room for a novel project and, for that matter, provided little more funding than would be absolutely necessary to produce research at virtually the same levels as in the preceding year or two. Happer asked the new subpanel to use the Administration's budget request for 1993 as a baseline and to consider the program priorities under three fiscal scenarios:

- ▷ a flat funding level, with no adjustment for inflation
- ▷ a flat funding level, adjusted for inflation of about 3% per year
- ▷ a modest funding increase, above inflation, of about 2% to 3% real growth per year.

To deal with Happer's unenviable task, HEPAP picked Michael S. Witherell, an experimentalist at the University of California at Santa Barbara, as chairman of the subpanel. The Witherell subpanel consisted of 17 members, including two from SLAC and two from the SSC Lab. The first thing Witherell did was to seek guidance from members of The American Physical Society's division of particles and fields, sending letters to its entire mailing list. He received responses from some 170 members. The subpanel visited CESR, the Cornell electron-positron storage ring, funded by the National Science Foundation, and four DOE high-energy physics accelerator centers, including the unfinished SSC Lab in Texas. On 13 April, Witherell gave HEPAP the subpanel's report.

HEPAP's response to Witherell's presentation was stunned silence. Among the findings of the Witherell subpanel: For the rest of the decade, it seems, US high-energy physics is

destined to be a zero-sum game. Only a few years ago this would have been considered wildly improbable. But as the SSC nears its construction phase and ramps up in staff and spending, it is obvious to everyone that there will be fewer funds available for improving facilities elsewhere, for taking on new projects or for operating existing labs. Witherell was explicit: "If you're going to start big things, you're going to have to turn off other things. That will maintain the balance of payments."

The picture of the field the Witherell group envisioned for the 1990s included upgrading Fermilab's main injector and constructing a B factory at SLAC, where the existing PEP tunnel would be used to collide beams of electrons and positrons at different energies to produce large numbers of B mesons. The subpanel sidestepped the question of whether NSF should fund a B factory at CESR. In fact, the subpanel danced around the issue of the competing proposals by SLAC and Cornell for a B factory. "Both proposals call for an upgrade of existing facilities to provide asymmetric energy e^+e^- rings running slightly above BB threshold as a way of studying CP violation, and both proposals have design luminosities of $3 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$. We were not in a position to evaluate technical and cost differences that exist between them."

Delaying a B factory

The subpanel's reluctance to deal with the matter was influenced by a letter coauthored by DOE and NSF officials on 9 January and addressed to Burton Richter, SLAC's director, and Karl Berkelman of Cornell, the architects of the B factories. The letter stated that neither agency would have any new money for the machines until at least fiscal 1997.

In an appearance before the subpanel, Richter announced an audacious plan to build the B factory out of SLAC's operating budget. By scaling back the operation of SLAC's linear collider from nine months to six months, Richter contends that he can shake loose about a quarter of his annual operating budget of \$140 million—enough money to start construction in 1994 and complete the machine in 1998.

The subpanel was pessimistic about the decade of the 1990s. "We assumed that the funding for the high-energy physics base program, after SSC turn-on and exclusive of the SSC Laboratory, would be smaller than in FY 1993," said the report. "Consistent with DOE guidance, the assumed reduction is about half of the current-

ly estimated annual budget of the SSC Laboratory"—or about \$307 million in fiscal 1991 dollars. But when the subpanel looked at the number of experimentalists entering the field, it was modestly optimistic. It projected increases of about 2% per year, from 1993 through 1997, stimulated by the "much expanded opportunities offered by the SSC."

Indeed, the subpanel claimed the second or third scenarios, showing small budget increases, would be just scarcely enough to maintain the vitality and diversity of the field. Using the second scenario, which the subpanel considered the most likely to happen, the Witherell group argued for funding the Fermilab upgrade for operation early in fiscal 1997 and for constructing the B factory in the existing PEP tunnel at SLAC for completion in 1996. Building a B factory would mean cutting back SLAC's experimental program, including research on Z particles. While DOE has not indicated whether SLAC will be allowed to go ahead, the subpanel found that if DOE obtained an additional \$20 million for high-energy physics in fiscal 1994 and 1995, the B factory could proceed.

Indeed, under the third scenario, the Witherell group sees construction of SLAC's B factory starting in fiscal 1994 and finishing in 1997. This scenario would also enable DOE to finance Fermilab's upgrade on a faster timetable.

Under the modest second scenario, the panel calls for DOE to allocate enough funds to Brookhaven to run the Alternating Gradient Synchrotron for 25 weeks per year through fiscal 1996, to complete the rare-K-decay experiments. The following year, the lab's high-energy program would cease and the AGS would become the injector for the Relativistic Heavy Ion Collider, now being built at Brookhaven.

Making unpleasant decisions

The toughest decision for the Witherell subpanel was its recommendation to close down the particle physics program at SLAC. Built in 1961 as a 20-GeV electron accelerator and upgraded in 1987 to collide electrons with positrons at 50 GeV in each beam, SLAC has a remarkable record, including four Nobel Prizes. The subpanel strongly supported SLAC's intention to conduct R&D for future linear colliders.

The subpanel's view of conditions in the field under the lowest-budget scenario set off alarm bells. "Damage to particle physics would be severe," the report asserts with force. "Less

physics would be done, and the field would be poorly positioned for the next decade."

If worst comes to worst, the future of the field is grim. In the lowest-budget scenario, concludes the Witherell report, accelerator operations at two laboratories, SLAC and Brookhaven, would stop over a period of two years, the number of particle physicists would shrink, and gains in understanding the fundamental laws of nature would slow considerably.

The subpanel rejected a proposal by the University of California at Los Angeles to build a 1-GeV e^+e^- accelerator producing phi mesons, mainly because such a machine is already being built in Italy. It also turned down proposals by Los Alamos, Lawrence Livermore and Oak Ridge to establish new high-energy physics groups, all to be supported by DOE. The reason the subpanel gave for scotching these plans was the current financial pressures on the program. "We recognize the scientific and technical talents available at these laboratories," it said with faint praise.

"This blueprint for the future of high-energy physics in this country is frightening," John Peoples, Fermilab's director, told HEPAP after Witherell had summarized the report. "Any budget scenario that closes SLAC and Brookhaven has Draconian

consequences because I know my lab will be next on the hit list."

Melvin Schwartz, associate director at Brookhaven, was dejected. "What the Witherell subpanel is telling us is that there will be few if any discoveries from 1995 to the end of the century," said Schwartz. "I hope they're wrong with their prediction. If they're right, it will be a sad time for particle physics."

Energy Department officials have said that if the SSC budget is approved by Congress for fiscal 1993, fully half of the budget for high-energy physics will be devoted to research at the lab in Texas. To be sure, the SSC's funding projections have raised some hackles. Even particle physicists are complaining that the two large detector experiments at the SSC would have annual budgets greater than most of the national laboratories'. Richter has observed that a burgeoning cadre of younger high-energy physicists are "turned off" by the impersonal style and bureaucratic operation of large-scale experiments involving several hundred researchers and that they are seeking to join smaller projects.

The Witherell report, like it or not, enables Congress to sharpen its knives. It reveals that the community is not well placed to defend itself.

—IRWIN GOODWIN

PCAST SETS HEARING DATES FOR STUDY OF UNIVERSITIES

Changes have been made in the schedule of public hearings by the President's Council of Advisers on Science and Technology on the mounting problems of the nation's research universities and their strained relationship with the Federal government (PHYSICS TODAY, June, page 62). The PCAST study, under the leadership of David Packard, chairman and co-founder of Hewlett-Packard, and Harold Shapiro, president of Princeton, comes at a time of discontent among faculty and administrators, as well as dismay among politicians and the public, over issues ranging from scientific misconduct and overhead costs to escalating tuition and pork-barrel politics. One indicator of the tumult in the groves of academe is the epidemic of resignations by presidents of several prestigious universities, including Chicago, Columbia, Duke and Yale.

PCAST has invited university officials, faculty and students to air their grievances, needs and ideas at a series of six public meetings. The first was

held at MIT on 24 June. Other dates have been revised from the preliminary listing. The new schedule is as follows: 15 July, University of California at Berkeley; 17 July, University of Texas at Austin; 21 July, Duke University, Durham, North Carolina; 24 July, National Academy of Sciences, Washington, DC; and 24 September, Northwestern University, Evanston, Illinois.

While encouraging academics to discuss the issues openly, D. Allan Bromley, the President's science adviser and the chairman of PCAST, fears that the council members may be swamped with requests to appear before them. He has asked those interested in appearing before PCAST to sign up in advance by notifying the study's office at 202-395-3170/3171 or at fax number 202-395-5076. The hearing at the National Academy of Sciences is essentially for leaders of higher-education associations and professional science or engineering societies.

—IRWIN GOODWIN ■