United States was about a year and he agrees, but again this was not included in his graph. As may be seen in his reference 2, his data for Norway, as compiled by Brudevoll, Liestøl, and Walløe, indicated that the data base for his Norwegian sample was in error. This was only demonstrated in 1979, but challenges to it existed in earlier articles. In short, I knew the articles cited by Tanner (and by Ellison), and I hold that Tanner maintained a drop in the menarcheal age which his own data did not support. Tanner is a significant and important scholar who is well deserving of his reputation. The fact that he encouraged articles reassessing his findings, as Ellison states, is indicative of this.

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Isabelle and U.S. Particle Physics

William J. Broad's article "Limping accelerator may fall to budget ax" (News and Comment, 21 Aug., p. 846) has the form of a requiem for Isabelle, the proton-proton colliding beam accelerator now under construction at Brookhaven National Laboratory, and for American particle physics research. It should be recognized that the problems of Isabelle are political and not technical. Here I use "political" not as a pejorative but as a rubric for the complex processes which any society must use to allocate its resources.

Isabelle's fiscal problems do not result from extremely costly technical failures. Instead, the budgetary difficulties stem largely from the inability of conventional funding and accounting methods to handle innovative development in the face of a continual inflationary devaluation of the dollar. Problems associated with the development of the superconducting ring magnets (which, as Broad points out, have now been largely solved) have delayed most of the construction of the machine for about 2 years. There is nothing unusual—or reprehensible—in the occurrence of difficulties in the development of radically new devices: of the five high-energy accelerators I have used in experiments, two—the Fermi National Accelerator and the Brookhaven Cosmotron—developed faults which required the rebuilding or replacement of all ring magnets. However, during the 2-year period of magnet development which delayed the construction of Isabelle, the dollars allocated for that construction lost value. At an inflationary rate of 12 percent per annum for technical goods and services, the dollar cost of the construction increased by about 25 percent. That increment, together with an equal deficit deriving from a government-imposed, unrealistic estimate of 6 percent annual inflation through the life of the project, accounts for most of the projected budget overrun.

Contrary to Broad's statement that Isabelle's cost is "many times larger than that of any other in the history of U.S. particle accelerators," Isabelle's projected costs are moderate and similar to those of other major U.S. accelerators. About $250 million was spent on the construction of the Fermi National Accelerator, completed in 1972. Using the Consumer Price Index as a measure of the loss of value of the dollar, that would be about $500 million in 1981 and more than the $360 million projected cost of Isabelle calculated similarly. Broad compares the projected cost of Isabelle with the PEP project construction cost of $78 million. But PEP was an addition to the Stanford Linear Accelerator (SLAC) finished in 1966, which cost $115 million. In 1981 dollars, SLAC plus PEP cost more than the projection for Isabelle.

Broad suggests that the required expenditure for Isabelle, if taken from the conventional high energy physics budget, may cripple U.S. particle physics research. This may be true; the fiscal constraints are now such that U.S. particle physics is no longer competitive with European efforts in this field. The European proton-antiproton collider, soon to be completed at CERN in Geneva, which Broad describes in a dubious metaphor as a "brilliant end run around Isabelle," operates in conjunction with the CERN SPS, a 400 proton synchrotron. The addition of such a facility to Isabelle was considered at least as early as 1972 (*1*), and the construction of a collider adjunct to the Fermilab accelerator was recommended as a first priority by the Fermilab Physics Advisory Committee meeting in the summer of 1976. But there wasn't enough money!

According to the testimony presented 23 July 1980 by John Adams, director general of CERN, before the House science and technology subcommittee, in 1966 both the United States and Western Europe spent about 0.025 percent of their gross national product (GNP) on particle physics. By 1978 the U.S. rate had dropped by a factor of 2, while Western Europe continued to spend at its 1966 rate. And the GNP of Western Europe is now greater than that of the United States. With Isabelle or without, lacking increased government support in the near future, U.S. particle physics will not be competitive with that of Europe (and perhaps not with that of the Soviet Union) for the remaining years of this century.

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References

1. R. Palmer, *Isabelle–Physics Prospects* (Report 17522, Brookhaven National Laboratory, Upton, N.Y., 1972).

Adair's point about developmental problems should be kept in perspective. Other accelerators have suffered technical difficulties, but the machines have nonetheless started on schedule. Fermilab, for instance, was completed 2 years early and $7 million under budget. It is Isabelle's 2-year delay that is creating much concern, especially because the Europeans are moving rapidly ahead.

Adair's method of arriving at the total cost of an accelerator is fine, but it can also be applied to Isabelle. Plans call for Isabelle to receive protons from the Alternating Gradient Synchrotron (AGS), which was built in 1960 at a cost of $92.8 million (in 1981 dollars, calculated on the basis of the Consumer Price Index). The AGS upgrade of 1973 cost $98.8 million, calculated in the same way. The cost of Isabelle, if completed, will be roughly $500 million. (Adair's $360 million covers construction costs but not accelerator R & D, prestartup operations, or the initial complement of equipment.) Adding the cost of the AGS brings the total to $691 million. This is 38 percent more than for Fermilab—previously the most expensive machine in the history of U.S. particle physics—and more than the cost of the machines built during the past two decades.—WILLIAM J. BROAD

Correction

Because a line was inadvertently omitted, the article "Reagan reforms create upheaval at NIOSH" (News and Comment, 9 Oct., p. 166) stated on p. 168 that Donald Millar, new director of the National Institute for Occupational Safety and Health (NIOSH), believes that NIOSH should be separated from the Centers for Disease Control in Atlanta. The sentence should have read, "Millar says one of the things he learned as acting director [of NIOSH] is that NIOSH should be moved to Atlanta or that its ties to CDC should be severed." Millar, who wants strengthened ties between NIOSH and CDC, favors the former alternative.

Erratum: In the report by J. E. Kutzbach (2 Oct., p. 59), an error appeared. On page 61, column 1, eight lines from the bottom of the page, the word "pressure" should be "precipitation."