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LETTERS

Funding the SSC

The discussion during 1992 about whether or not to continue funding the Superconducting Super Collider (SSC) was hardly an example of scientific clarity and accuracy. At least five arguments that were made for proceeding with the SSC deserve more careful scrutiny.

First, the argument was made that it is necessary for the United States to fund the SSC for the sake of national pride. This attitude now seems quaintly anachronistic. In 1992 both Corning and AT&T signed agreements with groups in Russia to carry out collaborative research in optoelectronics, while IBM, Toshiba, and Siemens signed an agreement to mutually develop the next generation of silicon memory chips. These high-technology fields are more relevant to national competitiveness than owning the highest energy accelerator. These corporations have faced the reality of a global economy and have realized that products requiring billion-dollar research investments can no longer be created alone, just for the sake of corporate or national pride. Perhaps it is time for the high-energy research community in the United States to join a global research community in the work that will be possible on CERN's (the European Organization for Nuclear Research's) new accelerator. Once the limits of that machine are exhausted, the community could then more sensibly argue for another that would represent an advance in global rather than national capability.

Second, arguments were made to imply that the high-energy experiments of the SSC are uniquely important. The SSC is indeed a worthy experiment that should be justified on the basis of its scientific merit because extending the frontiers of knowledge is a worthy challenge. However, this challenge is real for all fields of science and is not exclusive to high-energy physics. It is not possible to judge the intrinsic worthiness of important experiments in different fields of science. It is fruitless, for example, to compare the importance of finding out more about the origin of the universe with that of finding out more about the origin of life. The most important experiments in particle physics deserve support because they are likely to provide new understanding of the structure of the universe, but they are not necessarily the most important experiments in physics, chemistry, or biology.

Third, it has been said that, "[i]n the SSC we will gain experience with the first large-scale use of superconductivity. The SSC will transform superconductivity from a craft to an industrial capability" (*1*). The requirement for a large number of superconducting magnets for the SSC will be an anomalous market demand of relatively short duration. The superconducting industry has been built around today's products, such as magnets for magnetic resonance imaging (MRI) machines. In 1992, approximately 1100 such MRI systems were sold, each containing 20 to 40 miles of superconducting wire and representing a total revenue of $1.6 to $1.8 billion. The scientific discoveries that made such magnets possible were made during benchtop experiments in 1911 and the late 1950s and early 1960s.

The applications that will result from the SSC, quoted by Watkins (*1*)—maglev trains, ship propulsion, energy storage magnets, power transmission cables, motors, and generators—could be built quite adequately with today's technology. Some were built as prototypes a decade ago. The lack of widespread use of such products is not a result of unavailable technology but of inadequate market demand. The SSC will not suddenly create such a civilian market demand. The SSC will do nothing to enhance the nation's capability to make use of the new superconducting materials that were discovered in 1986. These would allow commercial systems to operate at higher temperatures (possibly cooled with liquid nitrogen rather than helium), which is a factor that would likely change their acceptance in the marketplace.

Fourth, the impression has been created that support from the scientific community for the SSC was "overwhelming." Despite the roughly 2000 signatures collected in support of the SSC, there was strong opposition to it across some parts of that community, particularly among the condensed matter scientists who make up the largest division of the American Physical Society.

Fifth, the impact of SSC expenditures (about $10 billion to construct and $1 billion a year for interest and operation) on other high-energy experiments and on other fields of science should have more carefully evaluated. The budget in the United States for the operation of high-energy experiments is about $630 million a year. Even allowing for the possibility of a 50% increase in funding for high-energy physics over the next decade, operation of the SSC would seem to consume all of the extrapolated annual budgets for high-energy research at universities ($100 million), Brookhaven National Laboratory ($90 million), Fermilab ($225 million), and the Stanford Linear Accelerator Center ($140 million). The net economic effect of funding the SSC is quite likely to be negative, in that money might be reduced in fields other than high-energy physics that have more consistently produced new and valuable spin-off technologies.

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References

1. J. Watkins, *Washington Post*, 21 July 1992, p. A19.

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Smitten by Quail

Long before the report by J. P. Dumbacher *et al.* "Homobatrachotoxin in the genus *Pitohui*: Chemical defense in birds?" (30 Oct., p. 799), there was mention of toxic birds in the Bible (Numbers 11:31–34). The citation describes quail carried into the Sinai Peninsula by "Winds from the sea" and gathered and eaten by the people of Israel. "While the flesh was yet between their teeth, ere it was chewed, the anger of the Lord was kindled against the people, and the Lord smote the people with a very great plague." Modern reports of toxic quail have been attributed to the neurotoxin coniine (*1*), which accumulates in the birds as a result of their eating hemlock during their migration from Africa to Europe.

The quail story suggests that toxins such as homobatrachotoxin may not be produced by animals themselves, but by exogenous sources such as microorganisms or by plants that are eaten by animals. This suggestion seems far more likely than the independent evolution of the same complex biosynthetic pathway in the two phylogenetically distant taxa that contain homobatrachotoxin, the pitohui bird and the poison-dart frog. Plants and microorganisms, which make a wide variety of chemicals (*2*), may be the source of homobatrachotoxin in these poisonous birds and frogs (or of precursors of the steroidal alkaloid that can be converted to the