overthrow of the Ptolemaic view of the universe? For Copernicus's society, the effect was negative, in the eyes of the church at least, but our society has assimilated the Copernican view into its everyday life. Copernicus could perhaps have been of more use to his society had he grown vegetables or designed siege engines. Perhaps a more pertinent question is whether we, as a society, need to know how we came to be here. This is the ingredient that I feel is missing from the SSC debate.

Finally, I wish Roy would define "social purpose." Who would decide whether high-energy physics or materials science has more of it? Does Roy speak of US society, Western society or the society of all people on the planet? Maybe our society does not need smoother surfaces so our engines run more efficiently. Perhaps instead our society needs a coherent picture of its place in the universe. My view is that there is at present too much emphasis on technology and short-range goals, at least in Western society. Most of our societal problems are political and not technological. Have nmr scanners or hybrid grains prolonged the life expectancy of those starving in Africa? Will an orbiting Maginot Line prevent nuclear-armed cruise missiles from striking the US? Will high-speed computers solve unemployment problems? I think not. If anything may be said, it is that technological "solutions" to political problems exacerbate those problems. There is no technological fix. What is needed is a basic restructuring of society's view of itself. I see the international cooperation in high-energy physics and other fields as a tentative model for a world society.

There are fundamental questions that physicists have pondered over many decades. These are problems that a physicist may solve but a politician cannot. The answers may or may not have a profound effect on tomorrow's society. In a matter of decades, without SSC, high-energy physics will become technology. With SSC, it will be as exciting as I find it now.

BRUCE R. BALLER
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5/86 *Minneapolis, Minnesota*

ROY REPLIES: Bruce Baller and I share many viewpoints, especially regarding the importance of political and economic decisions compared with technical ones, and the philosophical and religious import of particle physics. We share a desire to find out "what makes us . . . tick" and "how did we . . . get here." I am sure that a graduate student of Baller's sensitivity will be aware that for the vast majority of citizens those two questions are immensely more relevant insofar as they are concerned with the here and now: their families, neighborhood, jobs, next week, next year. Some of us are concerned with the first femtosecond of an event some 20×10^9 years ago. I teach cosmochemistry to 50 graduate students every fall and recall for them that during the 30 years I have taught the course the certainties of science have moved the age of the universe from 3.25 billion to about 20 billion years.

Baller and many others might misunderstand my stance on SSC and similar machines. I have no quarrel with their being built. It is only against the use of public funds for that purpose, at this juncture of the collapse of the American economy, that I argue. I suggest that Baller, who is used to astronomical numbers, acquaint himself with the size of the US deficit, the US debt, the annual carrying charges on just President Reagan's debt, the projected foreign debtor status of the US in 1990, and the extent of Japanese financing of the US debt. Then he could perhaps explain to the taxpayer in the Corn Belt or the ghetto why he feels he—and not some "welfare queen"—should be financed out of the public purse to pursue his—and my own—essentially religious pursuit. Fred Hoyle, editorializing in this very magazine (April 1968, page 149) said we should "recognize ourselves for what we are—the priests of a not very popular religion." Baller seems to agree, as do I. In a secular state couldn't some enlightened taxpayer say one day, "Try meditation instead, or get private financing."

RUSTUM ROY
Pennsylvania State University
10/86 *University Park, Pennsylvania*

SDI, its critics and theirs

One of the most important considerations in deciding whether it is appropriate to fund a particular piece of research is its timeliness. If the research does not grow in a suitable way from existing knowledge it is not interesting nor valuable.

When Secretary of Defense Caspar Weinberger replies to technical criticism of the Star Wars program by saying, "They said we couldn't fly" or "They said we could never get to the Moon," he is being deliberately disingenuous. If in the year 1800 the United States had begun to devote a large fraction of its disposable income to building a heavier-than-air flying machine, it seems to me a fair assumption

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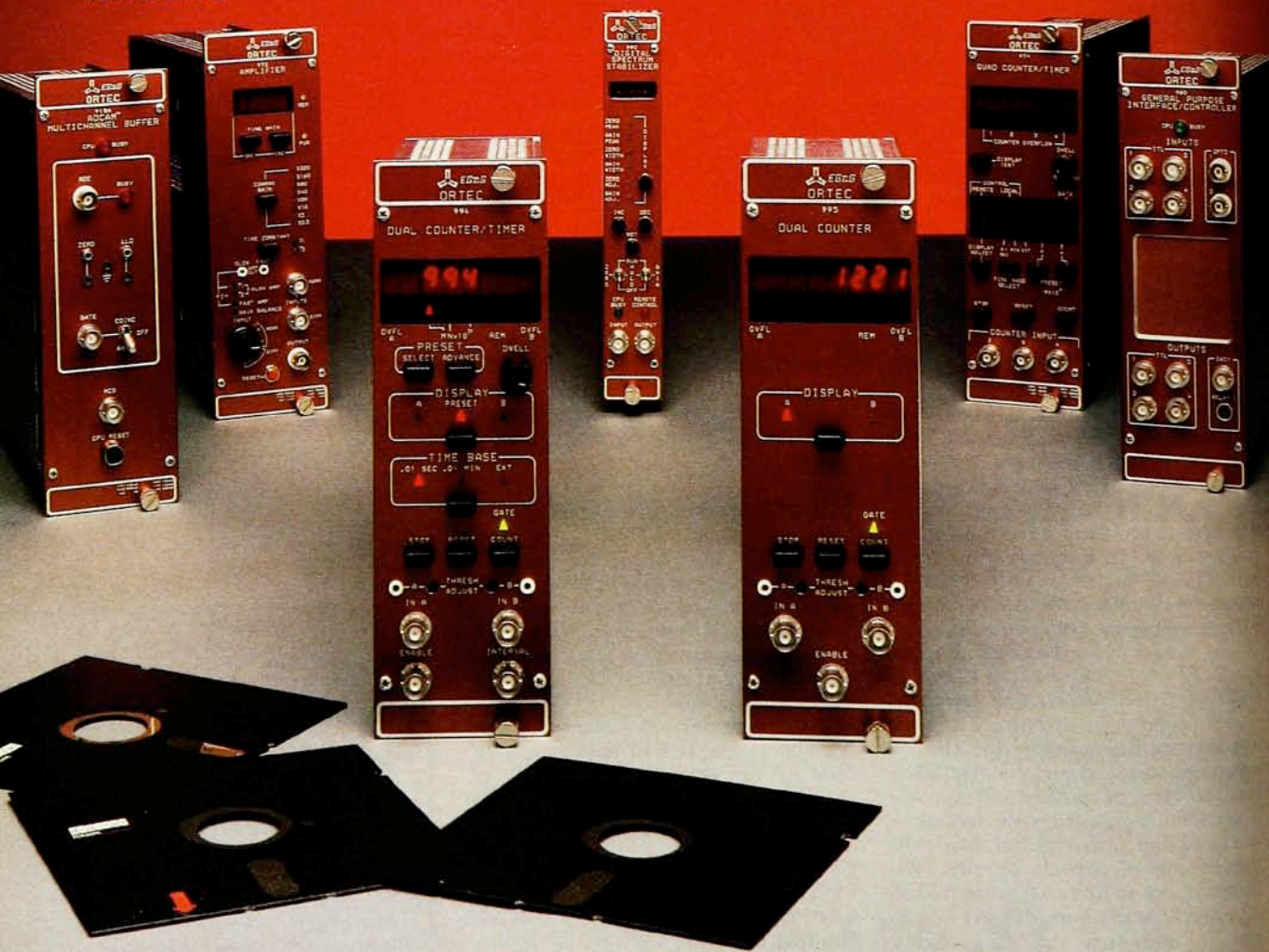

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that not only would the project have failed, but also it would have so distorted the economic activity of the country as to hinder development. Similarly a major program to send a man to the Moon, started in 1900 or even 1920, would, it seems to me, have taken resources from more worthwhile projects without significantly advancing the date on which one did set foot there.

A great part of the genius of past, successful major programs (for example, the Manhattan Project or the program to send a man to the Moon) was in choosing to start them at the right time. Even without exploring the full technical arguments about Star Wars, that major technical criticisms of the proposal go unanswered is enough to establish that this is *not* the time to begin.

Even if one day a system of defense against nuclear attack could be built, it does not follow that we should start research aimed at achieving it. The present technical criticism of the proposed methods of defense suggests that if a defensive system becomes possible, it will depend on principles quite different from those under consideration. In the same way, a program to build a flying machine in 1800 would presumably have wasted itself in trying to build a lighter reciprocating steam engine and more efficient flapping mechanisms. In the process it would have starved of attention just those basic sciences that gave rise to the technologies that eventually led to the solution of the problem (as well as starving those technologies that expanded the economy).

It would appear that those who are promoting the Star Wars program have let themselves become blinded by the power of science. The power is not unlimited. That we can formulate an aspiration does not guarantee that science can provide a technical means of achieving it.

J. A. EADES
University of Illinois at Urbana–Champaign

5/86

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I attended The American Physical Society's major "forum" on "SDI and its impact on the physics community" during the annual spring meeting in Washington, DC [see PHYSICS TODAY, April, page 81] and was quite disturbed by it.

The program would have been stacked against the Strategic Defense Initiative (as was true of an earlier session) even if the two representatives from the Defense Department had shown up.

The anti-SDI comments were composed mostly of ideological rhetoric, negative thinking and dubious assumptions leading to predictable conclusions. But what disturbed me most was the pervasive attitude that emerged toward the end of the program, which was characterized by a simplistic (should I say "knee-jerk"?) hostility toward physicists working on anything "military"—essentially weapons research of any kind. Various speakers and the audience commentators made an emotional, black-and-white distinction between "military" and "civilian" work, with military work and weapons being viewed as inherently and unremittingly evil and unacceptable. As a professional (a lawyer), I had expected to find a little more sophistication—not to mention common sense—among other professionals, especially a group of physicists.

One must ask whether these people consider the weapon worn by a police officer in Washington, DC, to be an unacceptable evil, or whether it, of necessity, performs a useful public service by helping to deter crime and protect the public (including physicists) from criminals.

One also must ask whether these scientists would have opposed the work of British scientists on radar and improved fighter aircraft in 1940, and would have considered it to be just as evil and unacceptable as the concurrent work by Nazi scientists on military rockets and the A-bomb.

It was also said that physicists should oppose the so-called nuclear arms race by refusing to do work relating to weapons in general (not simply nuclear weapons), and SDI in particular.

Yet SDI is primarily a non-nuclear *defensive* weapons concept that is intended (like antiaircraft weapons) to save lives—not take them—by preventing nuclear weapons from exploding on America, and ultimately to end the nuclear arms race. Even with the tenuous reasoning that argues that SDI would inevitably lead to a greater Soviet (not US) nuclear arms build-up, it is hard to see how these people twist their apparent values and arrive at an instantly engorged hatred of strategic defenses as being evil weapons.

The anwser may lie in their having an *a priori*, knee-jerk or ideological hostility to all (read "American") things military (you seldom hear these people condemning the Soviets' SS-18 first-strike force, their new SS-20s and 21s, or their violations of the ABM and SALT treaties—instead, as often as not, they attempt to rationalize away such threatening Soviet actions).

It should not be necessary to point

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letters

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out that in some particular circumstances in the real world, a given nation's (or group of nations') development of weapons can become not only a social necessity, but a positive moral good that helps preserve peace, freedom and life itself, and thereby benefits humanity. Depending on the outcome of research and testing, I would place SDI in such a category.

I personally consider most of those American scientists who worked on weapons to help America win the peace in World War II, and those who in the intervening years continued weapons work, to have served their country at least as well and honorably as any young volunteer Army private who helps protect America's peace. They deserve the gratitude of all Americans, and I hope that most physicists would agree with me.

Those who now, or in the future, work on SDI may one day also rightfully be regarded as American heroes who fully deserve the appreciation of all Americans, and even all humanity, for eventually making nuclear attack no longer a viable option for America's enemies, large or small, or for anyone. It is far too premature to assume otherwise.

JOHN KWAPISZ
Center for Peace and Freedom
5/86 *Washington, DC*

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I would like to make a point concerning the letters you have received (April, page 94) on the anti-Strategic Defense Initiative petition. It is not legitimate to make light of physicists who sign anti-SDI petitions simply because the signers would never apply for SDI grants anyway. Those who do military-related research, particularly SDI projects, have to overcome a tremendous built-in bias to petition against SDI. In essence, signers of anti-SDI petitions who don't work in SDI fields provide a natural balance to SDI researchers, who are inclined to favor SDI. Neither set of voices should be discounted in the debate.

JOHN DOWLING
Mansfield University
5/86 *Mansfield, Pennsylvania*

Ghost writing on SSC and SDI

I was recently in Bern and I got on the tram that Einstein used to take from the old clock tower to the Swiss Federal Patent Office and as I settled into a hard wooden seat and looked back at the clock face, a guttural voice whispered into my ear, "You are riding on a photon and the hands of the clock are frozen in time." I gripped the edge of the wooden seat to reassure myself that I was still in material reality, when the voice continued: "Relax, I was joking! I just wanted to introduce myself." It was Einstein! Before my mind had a chance to reply, he continued: "After the joke, a little seriousness. I have been concerned for some time about the following statement made by Leon Lederman in his reply to Rustum Roy (PHYSICS TODAY, September 1985, page 9): 'Let me add that the creators of the essential science for this technological revolution (... Albert Einstein ...) went on to discuss the issues and data out of the accelerator and astronomical laboratories, literally until their last gasp.' Unfortunately this is not correct, for two reasons: First, I was so shocked by the detonation of nuclear weapons in Japan, which was possible only as a result of the special theory, that I decided to suppress any further important results I might have obtained. Which I did. To confirm that my thoughts turned away from such matters toward peace let me quote my last signed letter, of 11 April 1955, to Bertrand Russell. In this letter I agreed to sign a manifesto urging all nations to renounce nuclear weapons and my last written words were 'Political passions, aroused everywhere, demand their victims.' Second, I am widely misquoted as saying, 'God does not play dice,' which nevertheless summarizes one of my major interests in my later years, which was God. Since God does not make SSCs I am not interested in them.

"What does interest me, given my unique perspective from ten-dimensional unified superstring space, is how humanity is going to survive in the coming decades. (After death one's soul goes through the ten to four dimension collapse in the reverse direction.) For the reality is, as God so frequently remarks to me, that just as Western society is embarking on the last leg of its road to self-destruction, so too is the high-energy physics community, that impeccable mirror of society, also embarking on its own little road to oblivion. No one seems to be aware of these two phenomena. Even the decision making is similar. Normally when anyone seriously considers investing a large sum of money (and $500 billion and $6 billion are both large sums) they will consider serious options. But the proposers of SDI and the proposers of SSC are unanimous in their promotion of a single choice. They do not consider various options rationally, but blindly and emotionally rush to support certain token goals. Can anyone explain that to me?

"More importantly, why does not the physics community propose, for example, a $6 billion program in peace research? What is peace? That is a very interesting physical question. How is it achieved? And so on. Such a program would have a far longer life than an SSC, thereby creating far more secure jobs, and might throw profound light on various problems of unification, both of physics and humanity. And it would have my blessing. Why then does no one propose it? One could deduce the answer to that question from what I have said already. In fact, the reason you cannot deduce the answer is the same reason you do not propose such a project."

R. J. ELLIS
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6/86 *Lausanne, Switzerland*

Magnetic order in $CePb_3$

In the December 1985 issue (page 21) Bruce Schechter reviewed recent discoveries on field-induced superconductivity. He mentioned neutron scattering experiments that failed to reveal any localized magnetic order in $CePb_3$. I do not know which experiments he was referring to, but I would like to inform PHYSICS TODAY readers that neutron scattering experiments on $CePb_3$ carried out at the High Flux Reactor of the Institut Laue–Langevin showed that $CePb_3$ does order magnetically with an incommensurate antiferromagnetic structure. Magnetism seems to be fairly localized in this compound. The results were submitted to *Physical Review Letters* in December 1985.

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Editor's note: The results were published in *Phys. Rev. Lett.* **56**, 1980 (1986).

Aquinas's cosmology

In his recent article (February 1986, page 24) Edward Harrison calls attention to Newton's suggestion that the universe is infinite in extent. Who first suggested that it might be of infinite age?

In discussing some of Aristotle's ideas Thomas Aquinas asks it it can be proven that the universe has existed for only a finite interval of time (*Summa Theologica*, vol. I, q. 46, a. 10,2). After bringing up the strongest arguments against a universe of infinite age he shows that such arguments can be refuted and hence that it is not possible