

## LETTERS

Who will be to blame if in ten years the public asks us what it is getting for its tax dollar, and we can only point to a file cabinet full of accountability forms? If we don't stand up and speak out, it will be us.

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MERMIN REPLIES: I applaud Alan Burnham's plea for sanity in the support of research. I wish, though, that we could all agree that virtually nobody believes that "I'm so smart, the public owes me the resources..." and stop issuing disclaimers or accusations. Anybody who takes that line as homeless people fill our cities, our schools deteriorate, our bridges fall down, our dumps overflow—you name it—isn't so smart after all. The real issue is, if in its wisdom (or folly) the nation wishes to continue to subsidize science and the training of scientists in the age of no (or at least not nearly enough) new taxes, how this is best done. There aren't easy answers, but Burnham is eloquent on how not to do it.

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## A History Lesson for NASA Management

I have just read with great interest and mounting frustration your account of the Hubble Space Telescope fiasco (August, page 17). Your reporter states that there is great mystification as to how such a blunder could have been allowed to occur.

The problem, I suggest, is that NASA in recent years has taken to running its projects by bureaucratic committee. No one demanded the necessary tests simply because it was no one's clear responsibility to do so—or more precisely, to *decide* whether or not such a thing should be done. The fact that an investigation has to be mounted to find out who was supposed to be responsible is enough in itself to prove my point.

I think it is obvious that NASA's projects must be managed—or perhaps commanded is a better word—like any genuinely well-run military operation, construction project, surgical operation or deep-sea voyage. There must be a clearly defined chain of command, with one and only one person in charge at each level of activity. Each manager at each level must have complete authority within his or her sphere of responsibility; in

turn, he or she must be held completely accountable for failure in that area. Long experience has proven that this is by far the most effective way to carry out any endeavor that demands a very high level of performance and cooperation from many people.

We should recall that Roman generals in Republican times were required to suicide if they lost a battle. This seems barbaric to us, but it reflects the early Romans' awareness of how high the stakes in life really are. I do not suggest that we require NASA project managers literally to fall on their swords if they fail significantly. But until NASA streamlines its command system it will continue to be plagued by embarrassing, costly and occasionally tragic disasters.

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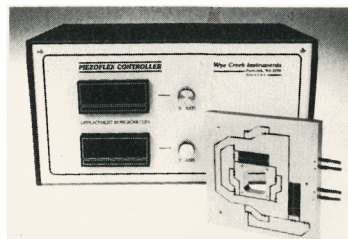
## Nonlinearity at the Naval Research Office

Peter Carruthers has written (October, page 96) concerning nonlinearity and complexity that "unfortunately there does not yet exist a Federal patron to sponsor this burgeoning and promising field of research." In fact, in 1984, the physics division at the Office of Naval Research initiated a core program on nonlinear dynamics, which has enjoyed monotonically increasing support for topics including chaos, fractals and complexity. An Accelerated Research Initiative on nonlinear phenomena, which was devoted to experimental research, spanned the years 1986-90, and a portion of an ARI (1988-92) on clusters is devoted to fractal aspects of materials. A joint physics and oceanography five-year ARI on the nonlinear dynamics of ocean surface waves will begin in fiscal year 1992. The ONR physics division has also managed Small Business Innovative Research programs on nonlinear iterated function systems for image compression, and large DARPA University Research Initiatives devoted to nonlinear dynamical approaches to fluid mechanics. Programs, such as neural networks, supported jointly by several other ONR divisions would also fall within Carruthers's topic of complexity. These programs have consistently received strong support from the ONR management, especially during our internal program competitions. The Navy has focused on and been an early and strong supporter of the rich and promising fields championed by

*continued on page 94*

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Carruthers, and we also would welcome growing support of these fields.

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11/90

## Putting Science into the Cabinet

Recently, a number of well-known individuals and organizations have backed the idea of a Cabinet-level Department of the Environment. While this idea is not without merit, an even more persuasive argument can be made for a Department of Science and Technology.

Since the 1970s we have witnessed a protracted decline in US technological prowess:

- ▷ US students received low scores on international math and science tests.
- ▷ Foreign inventors have increased their share of US patents from one-third in 1975 to the current level of almost half.
- ▷ The quality of key US products such as automobiles still significantly lags behind that of products made in Japan.
- ▷ The number of Americans pursuing graduate degrees has declined by over 40% in some areas of the physical sciences.
- ▷ The US share of the worldwide semiconductor market has declined by 50% since 1981.

While many Americans would point to such projects as the Superconducting Super Collider to be built in Texas as signs of American science on the rebound, these "big science" projects also demonstrate the failure of our Federal science policy.

"Star Wars," the SSC, the space station and the Hubble Telescope represent over \$50 billion in homage paid to big science by our Federal science bureaucracy. Relatively meager public funding has been provided for science education or for research in such key technology areas as microelectronics, ceramics, data storage or biotechnology. NSF constant-dollar funding for condensed matter physics research has actually declined during the past two years. Only 25 out of 250 recent proposals for research on high-temperature superconductors were funded by NSF. Sematech, the semiconductor manufacturing consortium, and a NASA mission to Halley's comet were also victims of limited funding.

While megascience projects have been the darling of the Federal science establishment, these types of projects have often been character-

ized by a relatively low level of technological return to our society. Nobel laureate Philip Anderson has estimated that the cost per scientist employed of such projects as the SSC is a factor of ten times higher than that of research in other areas of science.

Recombinant DNA, fiberoptics and high-temperature superconductors are all examples of minimally funded "small science" discoveries that will have a major impact on our society during the next 25 years. The controversial area of cold fusion research may yet prove to be another small-science breakthrough that greatly benefits our society.

The current myriad of Federal science agencies and programs insures that only the politically powerful and astute will prosper. During my eight years with NASA, it was instilled in me that the vitality of the agency was dependent on its ability to sell high-visibility big-science programs to the public and Congress. Combining such organizations as NASA, DOE, NSF, NOAA and the National Institute of Standards and Technology into a Cabinet-level department would diminish the pressure on each agency to engage in this type of self-promotion.

Other potential benefits of a centralized science administration to our society include reduced costs, increased efficiency, less interagency haggling over turf and improved coordination of national science policy with the research programs of universities and private industry.

A Department of Science and Technology would also be able to compete on a more level playing field with the Department of Defense for scarce Federal R&D dollars. Recent years have seen the Pentagon's share of the US R&D budget soar from 24% in 1981 to 55% in 1989. Due to its classified nature, the benefits of military research to the public are often lost or diluted.

Finally, and most importantly, a Department of Science and Technology makes political sense. It would send an important message to the public as well as to our international competitors, and would let President Bush be viewed as a proscience and efficiency-minded public administrator.

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4/90  
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## Social Sciences: Model for Physics Funding?

Is there a "funding crisis" in the sciences? I am an astronomer; my

wife is an anthropologist. Our research requirements are extremely similar: Both of us need to publish papers, travel to meetings and employ graduate students, and we both need a small desktop computer. Yet while I am expected to bring in on the order of \$60 000 a year in external funding, she, and most of her colleagues, get by with none at all. How do they manage? Their journals do not charge for publication; their graduate students earn their keep, by teaching or a part-time job; they buy their own computers and don't expect to be reimbursed for travel to professional meetings; they have never heard of "summer salary," except for those who teach summer courses; their department has few visiting lecturers; and post-docs are practically nonexistent. In fact, it is not uncommon for professors in her discipline to support research assistants out of their own pockets.

Of course, social scientists complain about the lack of funding too. My point is that most of us in the physical sciences could learn to get by with a lot less than we have become accustomed to. If young researchers are failing to attract grants, perhaps the Federal funding agencies should simply reduce the average award by 30% or 40%. We would still be far better off than our colleagues in the social sciences.

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10/90

## Pulsar Problems

The article "A New Class of Pulsars" (March 1990, page 26), written by Donald C. Backer and Shrinivas R. Kulkarni, two of the leading pulsar scientists in the US, does not make me happy. The article promises to "provide tools for fundamental tests of physics," but on page 33 the authors admit that the origins of the new class of pulsars "are still cloaked in mystery." By that time, however, they have drawn a number of "conclusions," none of which is without serious difficulties.

To begin with, the authors describe the binary, millisecond and globular-cluster pulsars as old objects, "with ages comparable to the age of the universe." This statement ignores data published by Kulkarni,<sup>1</sup> who reports that the pulsars 1937 + 21, 1957 + 20 and 0820 + 02 have kinetic ages  $(z - z_*)/z$  on the order of several hundred thousand years ( $z$  measures the distance from the Galactic plane,  $z_*$  the distance at birth), in conflict