Letters

Federal Science Appointments

Joseph Palca's article "Room at the top" (News & Comment, 3 Nov., p 566) does not mention one important post in the federal science bureaucracy that the Bush Administration did fill, on 22 May 1989—that of Assistant Secretary for Science and Education in the U.S. Department of Agriculture. This post is particularly important when one considers the pivotal role agriculture and agricultural research are playing as the United States deals with the critical issues of diet and health, food safety, the environment, global climate change, the challenges of biotechnology, and our nation's future as a competitor in science and in the world marketplace.

Recognition of agriculture's role in these issues is widespread, as evidenced by the National Research Council's recent recommendation of a $500 million new federal investment in research to address them.

While it is true that the process of finding people to fill top posts has been slow—in part due to low salaries—full credit should be given when a key position in science has been filled.

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The otherwise excellent article "Room at the top," detailing the administration's failure to fill second- and third-level science policy positions does not discuss one important issue. The salary levels of the second- and third-level positions barely exceed the salaries for upper-level associate professors at the better universities. It is time to face the fact that the quality of leadership in the federal science agencies will continue to erode until something is done to correct the deficiency in federal salaries.

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Sewage Treatment: A Moral?

The controversy about sewage treatment for Boston and San Diego (News & Comment, 27 Oct., p. 440) pits the technical judgment of respected academic scientists against the legalistic and inflexible Environmental Protection Agency (EPA) bureaucracy. The story contains an important moral, perhaps several.

There is the moral of the "free lunch" that actually costs more. When a group of friends forms a luncheon club where each takes his turn picking up the check, some pretty expensive lunches will be ordered. And so it is with sewage treatment plants. In the halcyon days after Earth Day 1970, the federal government (that is, all of us taxpayers) paid nearly all the capital cost. There followed an (over)investment in "gold-plated" municipal treatment plants with all the bells and whistles—no great surprise to anyone. (There is even a scholarly literature on this subject, embodied in the Averch-Johnson theorem.)

Not surprisingly, also, as the federal cost share declined—by law—municipalities became more and more concerned about cost. An analogous controversy is holding up acid-rain legislation: midwestern congressmen want "cost-sharing" for retrofitting old coal-fired power plants with smokestack scrubbers; they would otherwise opt for less expensive means for reducing emissions.

Another moral emerges from the story: with different technology, environmental environmental results almost as good can be had for a lot less money. In technical language, the marginal costs of tighter control far outweigh the marginal benefits from such controls. (The resources saved could be used for other worthy environmental, health, or social goals, now underfunded.)

Again, this is not surprising. Government has a long history of ignoring cost-benefit analysis, as well as scientific-technical data, in environmental decision making. Witness again current acid-rain bills before the Congress; the bills aim to remove 10 million tons of sulfur dioxide emissions per year at an annual cost of about $10 billion. But why 10 million tons—on top of the 8 million tons already removed by existing legislation? Why not 2, or 5, or even the whole 20 million tons? Is there a credible cost-benefit analysis behind the 10 million tons, or is it just a round political number derived by counting fingers?

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California Evolution Guideline

The 1989 "California science framework for public schools" ("guideline") is described by Marcia Barinaga (News & Comment, 15 Nov., p. 881) as "the first such guideline to include evolution as one of the core themes that are central to the understanding of science." Actually the 1978 framework, of which I was a coauthor, said that "all living organisms on earth have a common ancestor from which they have diverged by evolution during about 3 billion years" (*1*). The 1978 framework was unsuccessfully challenged by creationists who brought court action against the State Board of Education, demanding that all copies of the framework be recalled and that it be revised to meet their wishes. The court decision included a statement that "it would be presumptuous for this Court to revise the content of the Framework. . . ." (*2*).

This lesson seems to have been lost on the present board. On 26 June 1989, its president, Francis Laufenberg, told the committee responsible for the framework that "the statement . . . indicating that evolution is a fact and a theory is inconsistent with the Board's policy and should be corrected wherever it appears in the document." Laufenberg simultaneously requested modification of the passage that included summaries of the National Academy of Sciences statement on creationism and the ruling by the U.S. Supreme Court on *Edwards* v. *Aguillard*. The committee did not comply, and Laufenberg went over their heads to Bill Honig, who made the changes.

Barinaga quotes Eugenie Scott as saying that the "deletions were of little consequence," which underestimates their usefulness to creationists, and "apparently were necessary for Honig to get approval from the predominantly conservative school board." We shall never know this. It is also possible that a refusal to revise the framework might have mobilized support for science among board members, some of whom objected to appeasing the creationists. Unfortunately, a signal was given to creationists and book publishers that the board was willing to back down when challenged (*3*).

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REFERENCES

1. *Science Framework for Public Schools* (California State Board of Education, Sacramento, CA, 1978).
2. T. H. Jukes, *Perspect. Biol. Med.* **25**, 207 (1981).
3. J. Mathews, *Washington Post*, 7 November 1989, p. A7.

Costs of the National Aerospace Plane

George A. Keyworth II and Bruce Abell state that "[T]he fundamental barrier to reducing the costs of space launch with

rockets is technical—the need to carry on board both fuel and oxygen. That imposes an inescapable weight burden on rockets of any kind and a minimum cost of at least $5000 per pound to put something in space. The National Aerospace Plane (NASP), a third generation launcher, will nearly eliminate that oxygen penalty."

Keyworth and Abell are quite right. NASP will use the oxygen in the atmosphere to accelerate to near orbital speeds. While there will be savings with regard to the cost of carrying oxygen, however, other costs may offset these savings.

If one achieves high speeds in the atmosphere, one suffers a drag proportional to the density times the square of the speed. In order to overcome the enormous atmospheric drag of high speeds, enormous thrust is needed. The oxygen in the atmosphere needed to provide the thrust that overcomes the drag is also proportional to the density. Thus, higher altitudes mean not only less drag but less thrust. This thrust, of course, requires a large engine and additional fuel. Indeed, I don't believe anyone has demonstrated a high Mach–number (greater than 10) scramjet with a thrust greater than its drag. The larger engine and additional fuel required may offset the savings in oxygen weight, but one must also consider the weight penalties of thermal protection and structure required by the high heating rates and dynamic loads.

It is, therefore, not clear, as Keyworth and Abell state, that the NASP concept is an important one for launch vehicles. Nor does it seem likely that the NASP will provide efficient and effective high-speed transport.

Funds for the NASP program could be better used to provide the research for and the development of a Twenty-First Century supersonic transport. An aggressive program by NASA, and by aircraft and engine manufacturers, could provide a supersonic transport that would be economic in operation on long-distance ocean routes. While it is not likely that such a transport would repay any of its research and development costs, it would provide valuable improvements to civilian transport.

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Response: The design of the scramjet should enable it to provide nearly constant power over a wide range of altitudes. This is done by changes in the engine configuration in different speed regimes so that oxygen can be scooped up with optimal efficiency. The object of the current scramjet development program is to optimize the thrust of the engine at high altitudes. How to achieve Mach numbers greater than 10 is one of the program's central objectives. The simulations and measurements over the past year have so far strongly supported the premise that such high Mach numbers will be achieved. The central premise of our argument is that the National Aerospace Plane, unlike a rocket, can dramatically offset the oxidizer burden that contributes to the high cost of space access. The precise extent of that offset is the objective of the X-30 research program.

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ADA Deficiency Treatment

The article "ADA deficiency: A prime candidate" by Barbara J. Culliton (News & Comment, 10 Nov., p. 751) refers to treatment of immunodeficiency resulting from deficiency of adenosine deaminase (ADA) with polyethylene glycol–modified ADA (PEG-ADA). The article states that "after a few doses its effectiveness is often lost, for reasons that are not understood." This assessment is inaccurate.

Trials of PEG-ADA have been conducted in 12 patients for from 5 to 44 months (weekly dosing; 20 to 190 weekly injections per patient). Treatment with PEG-ADA has corrected the metabolic abnormalities caused by ADA deficiency in every patient, as judged by maintenance of plasma ADA at a level sufficient to eliminate deoxyadenosine triphosphate (dATP) in red cells, the biochemical goal of therapy. Objective improvement in tests of immune function has occurred in 11 patients, and clinical improvement has occurred in all 12. A misunderstanding seems to have arisen concerning information about one patient, in whom enhanced clearance of PEG-ADA occurred after 4 months due to development of antibody to ADA. The patient's treatment was interrupted for 8 weeks, but then was resumed. Immune tolerance to PEG-ADA was induced and this patient has now been receiving PEG-ADA for 7.5 months, with restoration of immune function and clinical improvement.

ADA deficiency is a very rare disorder, and the degree of immune dysfunction it causes is variable. As with other therapy for the type of immunodeficiency caused by ADA deficiency, for example, bone marrow transplantation, it may take years to assess accurately the degree of long-term clinical benefit from PEG-ADA. However, we are encouraged by results to date and feel that PEG-ADA has already been shown to be safe and effective. It is at this time the only example of effective enzyme replacement therapy for an inherited metabolic disease.

Enzyme replacement is a treatment, not a cure. We are encouraged by the efforts of Michael Blaese, his colleagues, and others to develop "gene replacement," which can, ideally, cure genetic diseases. Nevertheless, until safe and effective gene therapy is a reality, we plan to continue our efforts to develop enzyme replacement therapy for other metabolic diseases.

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Erratum: In the report "X-ray diffraction to 302 gigapascals: High-pressure crystal structure of cesium iodide" by H. K. Mao *et al.* (3 Nov., p. 649), reference 10, to a paper by R. Reichlin *et al.* [*Phys. Rev. Lett.* **56**, 2858 (1986)], was incorrectly numbered (*9*) in the text (p. 649, column 3, line 1; p. 650, column 1, line 49).