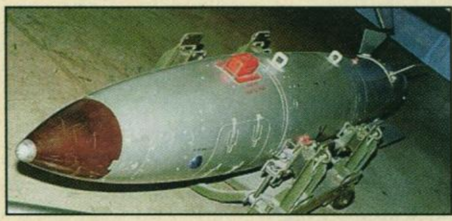
LETTERS

Half-life

Although many U.S. nuclear weapons are being "retired," a source of the hydrogen isotope tritium is needed if some of these weapons are to remain active. Readers discuss some alternatives: production by various methods, purchase from other countries, and disarmament by decay. (Right, a Mark-28 nuclear bomb) On other matters, some neuroscientists reach agreement that "neuron loss" in the hippocampus "is not required for age-associated cognitive impairment." And is the "scholarship of teaching" a "legitimate scholarly activity"?


USAF

Tritium Production

The editorial by Harold M. Agnew ("The nuclear fleecing of America," 13 Sept., p. 1475) repeats a number of fallacies and omits some critical details. It is not true, for instance, that the proton accelerator being proposed for accelerator production of tritium (APT) would "require the equivalent of a nuclear power plant to supply its electricity." Because of reduced weapons requirements, the need for tritium is far below the amount that could be produced by an accelerator operating with a full gigawatt of power, which is the normal production of a modern nuclear power reactor. The demand for tritium in the future is uncertain, but seems unlikely to rise to the levels needed during the Cold War. The APT design allows great flexibility in production rate, and of course needs negligible power if it is kept in a standby mode simply to ensure deterrence by demonstrating the capability to maintain the stockpile. The size and cost of APT can also be reduced if the demand for tritium is found to be reducing while an APT plant is still being designed.

As Agnew suggests, the choice of technology could be delayed if it proves possible to purchase tritium from Canada or Russia. In any case, it is important to make the right choice, not just to respond to charges of "fleecing" by someone who has been an outspoken advocate for the reactor industry. The U.S. Department of Energy officials who are responsible for reestablishing a supply of tritium are acutely aware that previous efforts to restart reactors resulted in environmental problems, which in turn brought about a halt to the efforts. In spite of these experiences, converting an existing commercial reactor might be the most economic approach. In view of the reduced and uncertain demand for tritium, the construction of a new reactor facility is not justified.

W. B. Herrmannsfeldt
Chairman,
External Review Committee for APT,
Stanford Linear Accelerator Center,
Stanford, CA 94309, USA
E-mail: wbhap@slac.stanford.edu

Agnew discusses scientific and political alternatives relating to an adequate supply of tritium in the future. While in general I support his analysis, I would like to point out an omission. There is exploratory research now being pursued (*1*) at the Los Alamos National Laboratories aimed at a new source for future tritium. Briefly, very small palladium wires (with diameters of 150 to 200 micrometers) are subjected to 2000 volts and 2.5 amperes in an atmosphere of deuterium at about 200 Torr (commonly referred to as glow or plasma discharge). Quantities of tritium are produced over hundreds of hours in amounts equivalent to 10's of nanocuries. While these quantities are far from the pounds of tritium ultimately required, the results are provocative. The substitution of platinum for palladium provides no tritium and when $^{1}H^{1}$ is substituted for $^{1}H^{2}$, tritium is produced at a much reduced quantity, although above that of the noise level. Great care has been taken to eliminate tritium from atmospheric pollution and metal containment. The experiments are reproducible.

Gustave K. Kohn
198 Pine Lane,
Los Altos, CA 94022, USA

References

1. T. N. Claytor, D. D. Jackson, D. G. Tuggle, in preparation (http://wwwde.esa.lanl.gov/tritweb.html, 5/7/96).

One of Agnew's arguments against an APT plant is that it would require the equivalent of a nuclear power plant and therefore would contribute to the nuclear waste that the country generates as part of its operation. Actually, the APT plant being designed to support a START-1–level stockpile would require approximately 400 megawatts, which is significantly less than the typical U.S. nuclear power plant requires. The nuclear waste produced by existing nuclear power plants would be produced regardless of the APT requirement, because demand for electricity is driven by needs far larger than the APT plant. The DOE *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (*1*) states that the APT requirement is less than 4% of the excess peak electric power available in the Savannah River, South Carolina, region, the proposed site for an APT plant. The APT design is flexible and can meet changing requirements for tritium production, while the electric power needs to support START-2 or future weapon levels would be low in proportion to the number of weapons.

Agnew also states that his proposal to purchase tritium from the Russians or Canadians would not have an impact on DOE strategy because we could delay the decision on a reactor or an accelerator 1 year at a time by buying 1 year's worth of tritium at a time. Then, he argues, if the supplier reneges on the agreement to supply tritium, we could continue along our original course toward a reactor or an accelerator.

Even if we ignore the fact that there are treaties and laws that prohibit the Canadians from selling us tritium for military purposes, Agnew's argument is flawed. His approach might work for a few years, but after a period of time of buying tritium (say 5 years), the expertise, the interest, and the detailed knowledge of the reactor or accelerator approach would be gone, and the country could not recreate it overnight. Part of the motivation for maintaining a U.S. nuclear deterrent is to provide a hedge against Russian instability. What happens if the supply is shut off and our relationship with the Russians turns sour? To me, it looks like the United States would begin to unilaterally disarm at the rate of decay of tritium, 5.5% per year. We would be irresponsible to present a U.S. president with that prospect.

John C. Browne
Los Alamos Neutron Science Center and Energy Research Programs, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

References

1. *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (DOE/EIS-0161, U.S. Department of Energy, Washington, DC, 1995).

Agnew appropriately identifies a compelling national challenge regarding the supply and cost of tritium for nuclear weapons. He does not, however, mention an available, cost-effective solution: the Fast Flux Test Facility (FFTF) near Richland, Washington.

Originally designed and operated as a materials test facility for the U.S. breeder reactor program, this modern, well-engineered reactor facility is also fully capable of operating as an efficient tritium-production facility (*1*). Among existing DOE reactors, only the FFTF could supply a significant percentage of the steady-state tritium requirement (*2*). The FFTF provides a bridge to more distant tritium-production alternatives—*without* dependence on Russia or other foreign suppliers. Effective use of the FFTF would avoid the major near-term construction costs that are of concern to Agnew.

Several other national needs are fulfilled by FFTF operations. Because it was originally designed to burn mixed-oxide fuel, the FFTF is an ideal facility to reduce the excess stockpile of weapons-grade plutonium. In addition, the core design, target volume, flux, and energy spectrum are suited to production of a broad array of radioisotopes needed for medical, industrial, and agricultural purposes (3). Built to the highest quality standards, the FFTF has a remaining life expectancy of 23 to 30 years.

During its 12 years of operations, the FFTF showed that it could safely operate at full power (400 megawatts thermal) for extended periods (128 days) and achieve high fuel burn-ups (238,000 megawatt days per metric ton). Given these facts, any prudent policy decision regarding tritium production should consider the capabilities of the FFTF.

Darrell R. Fisher, *Hanford Isotopes Program, Pacific Northwest National Laboratory, Richland, WA 99352, USA*; **Kenneth D. Dobbin**, *Safety Analysis and Nuclear Engineering Department, Fluor Daniel Northwest, Richland, WA 99352, USA*; **Alan R. Waltar**, *Past President, American Nuclear Society, 1617 Sunset, Richland, WA 99352, USA*; **Charles W. Lindenmeier**, *Advanced Nuclear and Medical Systems, 1933 Jadwin Avenue, Richland, WA 99352, USA*

References

1. Landis Committee, *Future Use of the United States Department of Energy's Fast Flux Test Facility* (Final Report of the Independent Review Team for the U.S. Department of Energy, Washington, DC, 1993), pp. 21–22.
2. *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (DOE/EIS-0161, U.S. Department of Energy, Washington, DC, 1995), p. ES-25.
3. S. W. Scott, *Scoping Assessment on Medical Isotope Production at the Fast Flux Test Facility* (WHC-SC-FF-RPT-010, Westinghouse Hanford Co., Richland, WA, 1996).

What would humorist Tom Lehrer have made of Agnew's proposal that Russia supply the tritium needed (in view of its 12-year half-life) to keep the U.S. hydrogen bomb in existence? Alternatively, the bomb could be allowed to die the most natural of deaths by radioactive decay. Contriving a secure lock on tritium production to enable this would be a worthwhile achievement on the part of the arms control community.

Peter J. Price
Garlen Road, Katonah, NY 10536, USA
E-mail: price@watson.ibm.com

Science for Nonmajors . . . and Majors

Maureen Scharberg's letter "Importance of teaching" (24 May, p. 1086) appears to miss the point of the News article about the National Science Foundation (NSF) report (*1*) on undergraduate education (J. Mervis, 19 Apr., p. 345). The issue raised by the report has nothing to do with the "scholarship of teaching." Rather, it deals with the perceived need for university faculty to pay more attention, not to teaching, but to undergraduates who are *not* science majors.

NSF's education chief Luther Williams has pointed out that university structures that have evolved in response to an imperative to educate scientists cannot be expected to modify their emphases merely because NSF says to do so.

The situation is not an "either-or" criticism of doctoral institutions. Ample evidence exists for the importance of undergraduate education to doctoral faculty. Doctoral research does not preclude commitment to undergraduate education; it increasingly embraces it. The strength of the U.S. system of higher learning is its enormous scope and its wide-ranging diversity, offering settings for just about any type