

LETTERS

incentives to overwork technical employees would have the dual societal benefits of reducing unemployment and underemployment and of improving the quality of life for those who are employed. Drawing the line between technical employees and management employees presents some difficulty, but the present system of placing all salaried professional employees in the exempt category makes little sense. While I realize that professional societies such as the APS or IEEE are not labor unions, it would be desirable for them to pay attention to issues such as these, which strongly affect the work environment and employment possibilities of their members.

FRED UNTERLEITNER
Santa Clara, Utah

12/93

It is not so much that we need nuclear weapons right now as that we must be thoroughly competent to handle the unexpected in the future, near or distant. It is easy to imagine realistic scenarios in which nuclear expertise or the ability to threaten nuclear retaliation will be desperately needed. We hope these scenarios will never happen, but examples and potential threats abound. My generation (and others) suffered terribly, unbelievably in World War II because in peacetime we had disarmed, so that we were woefully unprepared to prevent or fight wars. As it was true in the past, it remains true now and always: *Si vis pacem, para bellam*. ("If you want peace, prepare for war.")

JOSEPH J. DEVANEY
Los Alamos, New Mexico

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Nuclear Expertise Must Survive Disarmament

Believing that it ensures peace and that we are the very paragons of peace-loving virtue, the United States is recklessly destroying its nuclear weapons competence. We are destroying much much more than the intercontinental missiles necessary to reassure the Russians of our peaceful intentions toward them.

We are destroying not only weapons but records, facilities, careers, knowledge and competence. These attributes were dearly bought by decades of research and development by dedicated scientists, engineers, technicians and machinists. We still need these attributes to detect, comprehend and respond to foreign nuclear developments as well as specifically for our own defense weaponry. The ongoing destruction includes not only theoretical knowledge but also the all-important "hands on" arts that are essential to design, fabrication, maintenance, safe handling, safe storage and safe disposal of nuclear devices. Once gone, this expertise cannot be retrieved, short of a semi-Manhattan-Project-type effort. We are least likely to have the time and ability to redevelop the expertise when the need for it is greatest.

We are not facing up to two extremely unpleasant facts: Human nature has not changed, and the nuclear weapons genie is irretrievably out of the bottle. The knowledge of how to build nuclear weapons will inevitably continue to spread, and as a matter of fact, right now it appears likely that more and more of the world's fanatical or unstable countries will possess them.

Mercury's Perihelion Precession, Precisely

Daniel Kleppner (April 1993, page 9) writes that "according to general relativity Mercury's perihelion should precess at a rate of 43 seconds of arc per century."

This seemingly simple number has a rich history. What Einstein so ably explained was the observed excess argument of perihelion. The problem of the discrepancy between the measured precession and the classically calculated precession was known in the 1850s to Urbain Jean Joseph Le Verrier, one of the predictors of the existence of Neptune, and its value was refined in the 1880s by Simon Newcomb, one of my heroes. (Einstein held Newcomb's work in high regard, I seem to recall.) The total advance is about 5599 arcsec per Julian century with respect to the geocenter, our observation platform. The precession of the equinoxes of the Earth contributes approximately 5025 arcsec to that sum. The classical, or Newtonian, contribution of the other planets through the *N*-body interactions is approximately 531 arcsec. Subtracting yields about 43 arcseconds.

Einstein himself gave "43" per century¹ for the general relativistic contribution to the precession; the modern theoretical value is approximately 42.98 arcsec.

Reference

1. H. A. Lorentz, A. Einstein, H. Minkowski, H. Weyl, *The Principle of Relativity*, translated by W. Perrett, G. B. Jeffery, Dover, New York (1923), p. 164.

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