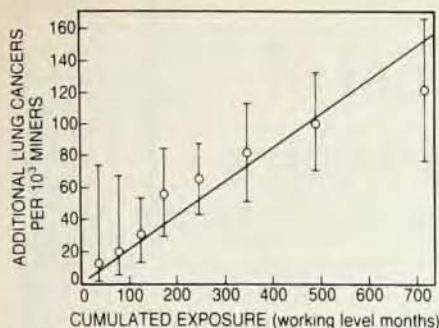




Increase in lung cancer for Czechoslovakian uranium miners as a function of dose from radon daughters. Redrawn from reference 5 with permission of the Health Physics Society.

As noted in my Guest Comment, it is regrettable that no public agency has accepted the mission of testing the indoor environment for Rn^{222} , even in cases where undesirable levels are suspected to be present.

To my knowledge there is only one commercial service that will give the type of measurement that is appropriate, a year-long integrated measurement. This is the type of reading that we have made ourselves in our limited survey of upper New York State and is done by means of a solid-state nuclear track detector in a housing that allows only radon gas to be admitted. The result is an unambiguous reading, free from effects of ambient aerosols and soil particles. Although readings over more limited times are of interest in understanding elevated radon levels, it is the long-term average that is most pertinent to inferring radiation doses of consequence. Because we have found that summer and winter radon concentrations can differ markedly in an as yet unpredictable manner,¹ a full-year integration is my recommendation. In addition to covering a more meaningful period of time, the long integrating time will allow good statistical significance of the measurements at a reasonable cost.

The radon-monitoring service is supplied by Terradex Corporation (460 N. Wiget Land, Walnut Creek, California 94598), with which we at General Electric have interacted strongly over the years. Terradex has done several tens of thousands of measurements in homes in the US and Europe. The current price for radon is \$16.50 per reading, if done in lots of fifty. Of several configurations that Terradex offers, the "filtered cup" is the most appropriate for home monitoring, since it gives the maximum sensitivity for a radon-only reading.

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11/81

Quality in science education

I was pleased to note the importance that PHYSICS TODAY places on leadership in science education (editorial by Harold Davis, September, page 152). Unfortunately I do not feel Davis makes a thoroughly convincing case nor does he describe a program that is likely to achieve its objectives. First of all, he understates the military threat posed by the Soviet Union's increasing emphasis on science education. It is not enough for us to maintain, as I am sure we will, our leadership in the productivity of first-rate scientists. If the soldier in the field has a fifteenth-century understanding of twenty-first-century equipment, that equipment cannot last long. A comparison of the performance of our aircraft carrier maintenance crews during WWII in the Pacific with that of the same crews two years ago off Iran illustrates the problem. The contrast between Israeli and Egyptian maintenance personnel in 1967 again demonstrates that this is a critical issue even during brief modern engagements.

The economic threat from Germany and Japan is at least as serious as the military problem and for the same reasons. Technological advances may only compound these difficulties. Twenty years ago a large part of one's technical training could be obtained out of school by fiddling with the family car. Today air-pollution accessories

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letters

and microprocessors tend to thwart such learning. The home computer may bring programming to the general public but it is unlikely to promote an understanding of anything akin to mechanics or classical physics.

While there is little doubt of the importance of science and mathematics education to the future of this country, there is, and should be, controversy over how it can be improved. Unfortunately, both Davis and the House committee advocate continuance of approaches which have failed us in the past. While I take strong exception with the Administration's cuts to the NSF science education program, they do at least provide us with the opportunity to re-evaluate what we are doing. These cuts are in fact a reflection of the support that program has—both at the highest levels of NSF and among the members of the National Science board. In these circles it is generally, and not altogether erroneously, believed that the NSF science education programs were more "of the quality one would expect from a school of education" than of what one would hope to obtain from first-rate scientists. With few but critical exceptions the NSF education programs failed to attract the participation of outstanding talent.

However, eminent scientists such as Frederick Reif and Nobel Laureate Herbert Simon were participants in the new cognitively oriented programs of research in science education. Yet nowhere are these programs mentioned by either Davis or the House committee. NSF educational development programs oriented to the uses of new technology attracted mathematicians like Seymour Papert and physicists like Alfred Bork (see, *PHYSICS TODAY*, September 1981, page 24, for a description of Bork's work). Projects of this type require a decade or more of sustained effort before their results can be put to general use. Papert's LOGO system (which I believe will prove the single most important advancement in mathematics education ever) began in the early seventies and is only this winter becoming widely available. Anyone who compares the educational software generally available for micros with that in LOGO will quickly understand the value of long-term NSF support. Yet research and development programs of this type accounted for only 10% of the education budget.

Thus the danger lies not so much in the size of the cut in NSF education (though that is a serious threat) as in what has been cut (research) and in what remains (graduate fellowships, undergraduate equipment and teacher training). While I favor federal fellow-

ships, any serious shortfall in that area is likely to be picked up by industry. So is funding of essential undergraduate equipment. Furthermore, with the exception of microcomputers, I doubt we need much additional equipment to teach real physics. Gadgets only obfuscate the essential features, and I believe they stimulate the interest of teachers more than that of their students. There can be no doubt of the need to do more to train first-rate teachers, but most of our past efforts in that direction have not worked well. *New programs* are needed that can attract talent adequate to the task. In this regard I find it amusing that in all the concern over Germany, Japan and the Soviet Union, I have never heard it suggested that we look seriously at how their educational systems function. Until the best minds in American science see science education as a problem worthy of investigation, federal programs may not make much difference. The greatest tragedy of the Reagan cuts is that they eliminate those few areas in which serious work was being done.

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10/81

Working in defense

In the correspondence (August 1981, page 11) concerning the Panel on Public Affairs of the APS, Louis Rosen remarks that "One obvious way to decrease the probability of a major conflict is to make it extremely unattractive militarily, socially and economically for any nation to start a war. Physicists are certainly helping to do that."

Perhaps, but also many physicists are working on projects that may well enhance the dangers of nuclear war by accident, of pre-emptive nuclear attack, and, most serious of all, of escalation of conventional into nuclear war.

Consider, for example, the miniaturization of fission weapons and development of guidance systems that has led to the deployment in Europe of several thousand "low-yield" (order of a kiloton) high-accuracy battlefield nuclear weapons. Present NATO policy is to meet a conventional attack from the East with such weapons (because, NATO claims, its conventional forces are too weak to hold the line), and so to conduct a limited, or theater, nuclear war. Almost certainly there would be a nuclear response from the other side, and the exchange would then escalate quickly into a major nuclear war, at the very least devastating the whole of Central Europe. This is the conclusion of responsible military analysts and strategists such as the late Lord Mount-

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