

rich enough to meet the country's power needs for centuries, no matter how much energy consumption may grow. (Emphasis has been added)

We can not wonder that the American people are confused about the energy crisis.

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5/12/78

Even fewer students

In his article "The APS in 1977" in April (page 23) George Pake gives a projection of the college age population as a function of time up to the year 2000. The projection shows a decline from a peak of 18 million in 1980 to a figure of 14 million in 1990 followed by an upturn to about 18.5 million in 2000. Pake points out this 1977 projection is an appreciable downward revision of an earlier 1964 projection.

Unfortunately for the future market for physics teachers, this 1977 projection is also almost certainly too high. If the current fertility rates of 1.7-1.8 (births per woman) are maintained until 1982, the college age population (18-21 years) in the year 2000 will be slightly above 13 million people.¹ Immigration is included in this estimate.

It should be noted that the current college age population is about 16 million.

Reference

1. *Statistical Abstract of the United States: 1977*, US Dept. of Commerce (September 1977); page 6.

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5/1/78

Opportunities in sales

On the subject of career opportunities for physicists, I wonder how many are aware of a terrible shortage of highly qualified sales personnel in the high-technology industries. Not just door-knockers, or even "sales engineers," but people with an ability for quick understanding of a novel complex problem of a customer, who knows what can and cannot be done technically, who can devise a proposed solution, write it up as a proposal, persuade the customer to buy, and then follow up afterward.

As president of a company that needs such people, I know how very scarce they are. As a professor of physics (University of Pittsburgh), I also know the abundance of people on their second or third temporary soft-money postdoc appointment, and the concerns of the assistant professor with no chance of getting tenure. Some changing of career goals can help solve both problems.

Being a "Technical Representative" is certainly not for everyone. But for the person with a few years of good diversified post-doctoral experience, who likes to interact persuasively with people and has a good personality and appearance, who enjoys bouncing from one technical challenge to another, who can write, who would like an income potential substantially better than that of the average practicing scientist and perhaps eventually want to move into corporate management, and practice a profession that is in demand while using his physics background, this new career should be considered. The career opportunities in technical representation will expand just as surely as technology will.

I will be glad to go into more detail about this new field of opportunity for physicists with anybody who wants to know more, with the warning in advance that if his background is right, he is apt to get a job offer.

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5/4/78

Technical controversies

Controversies on several scientifically oriented topics appear to have led to unreconcilable and almost uncontrolled debate in the political arena and in the letters sections of several publications. Demonstrations and counter-demonstrations also continue to be used to emphasize particular points of view. At the time of the writing of this letter, energy legislation proposed by President Carter had been languishing in Congress for about 15 months, largely because most senators and representatives apparently endorse what they believe to be the best regional interests of their constituents rather than trying to reach an understanding as to what is in the best interests of the nation as a whole. The nuclear-energy debate appears to have no possible satisfactory conclusion. Other controversies include the pitting of ecological and environmental proponents against advocates of economic growth, the so-called "soft" energy path advocates against the "hard" energy path advocates, and debates over the B-1 bomber, the neutron bomb and military equipment sales to the Middle East. Often in these debates "experts" with scientific background appear to contradict one another. The contradictions often seem to arise because the experts do not clearly indicate when they are no longer quoting facts but are expressing opinions. Sometimes I wonder if they are themselves aware of the transformation.

Occasionally a decision has been reached, at least temporarily. In one such decision Congress decided shortly after World War II to establish the Atomic

Energy Commission with the express purpose of developing nuclear energy. We can look in retrospect and wonder if that decision was wise, but we must remember that hindsight always has a better chance of being correct than foresight. Even in hindsight only three possible decisions existed for the Congress at that time, since only coal, solar energy and nuclear energy existed in sufficient quantities to provide viable alternatives to oil and natural gas.

One may ask why Congress did not establish a Solar Energy Commission at the time it established the Atomic Energy Commission. However, in the late 1940's we already had enough experience to know that the per-kilowatt initial capital costs of solar energy were extremely large, at least in comparison with the capital costs of fossil-fueled electric power stations. On the other hand we were flushed with success from our one application of nuclear energy in World War II. The development of nuclear weapons had been so easy that it appeared likely that peaceful uses of nuclear energy could also be made into a relatively easy success story. It was impossible to foresee all the political, environmental and economic controversies that would rage regarding nuclear energy during the next few decades.

As I look at the many current controversies that require some degree of scientific or technical knowledge, I sometimes wonder if we still possess the capability to do long-range planning of the type we need to maintain a reasonably decent standard of living. Controversies appear to be growing both in numbers and in complexity. I see no real ability in any agency of the Federal government or in any other group to settle them. Indecision may prevail even more strongly in Congress than in the Executive Branch and among the general public. These observations lead me to wonder how long our democracy can survive before it is inundated by its inability to make decisions, especially decisions that require the use of scientific and technical information of a reasonably sophisticated nature.

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7/5/78

Author-written abstracts

In reply to the letter from Andrzej Krasinski in March (page 15), I would like to point out that there is an alternative to *Physics Abstracts*. The American Institute of Physics publishes the quarterly *Current Physics Index*, which is not comprehensive in its journal coverage (it covers about 90% of the US physics literature) but instead gives the abstracts in exactly the form written by the authors and for the major American journals

provides them in a very timely fashion. The third major virtue of this quarterly is its price, which is \$95.00, and includes two additional year-end cumulative volumes (by subject and by author). The price to members of member societies of the American Institute of Physics is only \$30.00. The price for the cumulative annual index alone is \$50.00. This annual index does not include abstracts but does include the institutional affiliations of the authors.

A. W. K. METZNER
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5/3/78

Particle poetry

Sidney Drell's article "When is a Particle?" in June (page 23) inspired the following doggerel (with apologies to Gelett Burgess and René Descartes):

I've never seen a quark;
I've often hoped to see one.
But this I know and know full well,
Though we can't see,
We all agree:
NON VIDEMUS ERGO EST!

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Counterculture dialogue

Members of the countercultures have questioned the value of science and technology. Dialogue with them is often difficult. I suggest that we may promote needed dialogue about the values of science and technology by first focusing upon the contexts within which scientists' values are appropriate, and upon the contexts within which many of the counterculture values are appropriate.

Such a focus will help us all avoid inappropriate affirmations of values—affirmations that may appear arrogant to some. It is not helpful to affirm values outside the "range of their propriety"—any more than it is helpful to stick to Newtonian Mechanics in situations that call for Lorentz transformations, quantum mechanics, and/or warped-space equations. We will do a better job of teaching scientists' values and of helping the supporting public understand them if we take care to indicate the limited contexts in which our professional values are appropriate, and the other contexts within which they are inappropriate. Modesty wins friends. Apparent arrogance loses friends.

Scientists' professional values do not form a good basis for promoting dialogue with non-technical people; in fact, scientists' professional values often undermine dialogue. Before we can "sell science" we

must understand our audience on its own terms. We must develop a mutual understanding of the situations in which our values as scientists occasion conflict with (or are tangential to) the values that are central to the personal lives of the non-technical people who support us.

Technical studies will not help us transcend our technical preoccupations. The kinds of insight and understanding we need can come only through a transdisciplinary approach that involves equally both technically and nontechnically oriented people who are all primarily concerned with promoting two-way communication—that is, dialogue. I will be developing these and related ideas while on sabbatical this fall—and solicit communications from readers with similar interests and concerns.

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7/24/78

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Plutonium-free bomb

I very much appreciated the article "Nuclear power and nuclear-weapons proliferation" by Ernest J. Moniz and Thomas L. Neff that appeared in the April issue (page 42). Of all the information I acquired in perusing the article, the most astonishing is the discovery, based upon the figure on page 44, of the extreme potency of plutonium as a bomb material. For, it would appear, one could reduce the fissile content of plutonium to 0% and still produce a bomb with a critical mass of 20 kg—a plutonium-free plutonium bomb!

I checked the reference cited in the figure caption. Only the points with fissile content $\geq 50\%$ are cited there, together with the information that the non-fissile material is plutonium 240 and 242. Surely the curve must rise to infinite critical mass as the fissile content falls to zero? Or am I so out of touch with this subject as to believe that fissile materials are essential to a fission bomb?

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4/14/78

THE AUTHORS COMMENT: We regret any confusion caused some readers by the graph of critical mass versus fissile content shown in our article. As implied on page 42, "fissile content" refers to the isotopic fraction fissionable by thermal neutrons (the odd-mass isotopes of uranium and plutonium). However, the critical mass is that in a fast neutron spectrum, as produced by the fission process (see the box on page 51). Thermal neutrons, while clearly of great importance in reactors, cannot play an essential role in a nuclear weapon, because the monitoring time is too long to allow supercritical assembly.

Isotopes that are not thermally fissile

may contribute to a nuclear explosion if the threshold for fast neutron induced fission is sufficiently low and the corresponding cross section sufficiently high. This is not the case for U^{238} ; the fission threshold is about 1 MeV, leading to a neutron multiplication factor of about one half. On the other hand, all the plutonium isotopes have low fission thresholds, substantial fission cross sections, and therefore fairly small critical masses. Indeed, the prompt critical mass for a sphere of Pu^{240} is smaller than that for weapons-grade uranium!

ERNEST J. MONIZ
THOMAS L. NEFF

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5/11/78
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More oppressed physicists

We were comforted to see the Guest Comment about oppressed physicists by Bernard Cooper and John Parmentola in August (page 9). It may be useful to point out that their lists of oppressed physicists are not exhaustive. In particular, for the case of Argentina, in which we have been involved through the "Comité pour la Liberation des Physiciens Argentins Emprisonnés"¹ and the American Association for the Advancement of Science,² we know of the following additional physicists:

Missing or imprisoned:

A. Calvo
R. D. Chidichimo
H. D'Olive

Killed:

M. Tarchinsky

We would like to report that E. Sevilla has been released and is now in the US.

We feel it is also pertinent to remember that there are many additional Argentinian physicists who have been fired from their positions and are still looking for work either at home or abroad.

References

1. C. D. Dominicis is a founding member of "Comite pour la Liberation des Physiciens Argentins Emprisonnes," chaired by A. Kastler. For information or a copy of the committee bulletin, write to Pierie Moussa DPHT CENS BP2 91190 Gif Sur Yvette, France. See also letter to PHYSICS TODAY February 1977, page 15.
2. J. P. Primack is a member of the AAAS Committee on Scientific Freedom and Responsibility, which has established a Clearinghouse on Persecuted Foreign Scientists. For more information, including a detailed report on scientific freedom in Argentina, contact the Human Rights Coordinator, AAAS, 1515 Massachusetts Ave. NW, Washington, D.C. 20005.

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