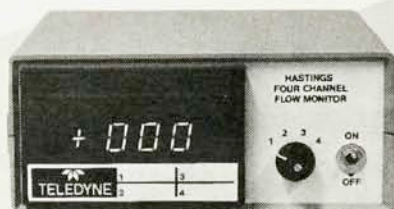


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letters

ment to use the nuclear waste; storage was the cost-effective strategy.

Nowadays energy is no longer cheap; use could be cost effective if public capital investment could be shaken loose for some novel approaches to use. The objection today is largely emotional. If the 100-year problem is solved, the 1000-year problem is put forward as a crisis. If the 1000-year problem is solved, bring on the 10 000 year problem, which is insoluble by definition. (The human race doesn't have 10 000 years of remembered experience).

The biosphere is far less tender than those who would save it would have us believe. It has already survived a massive natural reactor which burned ages ago in what are now the uranium mines of the Congo, without the benefit of any kind of protection.

A sense of perspective is in order. The fissionable material now in weapons is the threat to mankind, not the powerplants. If only we could begin to burn those warheads for useful power, the threat to the human race would be immeasurably reduced, no matter how careless we became with the powerplant waste product!

The ten tons of ash from a 1000-MW reactor still has an output of 3 MW, give or take a factor of 3; it has already produced \$100 000 000 in revenue at 1 cent per kWh. A modest fraction of that sum will buy a lot of lead and a lot of pipe for using the ash.

3 MW is a bit much to heat my house, but it would do very nicely for a public building complex, such as the heating plant of the local Army base or Air Force station. Mind you, it would be cheaper in the short run (especially if your insist on solving 10 000 year problems first) to burn imported oil. But in the long run, as those warheads become power-plant fuel, using the "waste" to heat buildings would be cheap and life-protecting.

ROBERT M. LERNER

1/83

Harvard, Massachusetts

Helium-3 from hot springs

The recent profile of Philip Morrison (August, page 36) contains an elegant and instructive quote from Hans Bethe that is reminiscent of Lord Kelvin's theory of the cooling history of the Earth (in that an unexpected phenomenon, in Kelvin's case radioactivity, made the theory totally incorrect). Bethe refers to the well-known calculations of Morrison and Pine on the production rates of He^3 and He^4 by radioactivity in the crust, which showed that the He^3/He^4 ratio in radiogenic helium in rocks is less than one-tenth the ratio in atmospheric helium.

Bethe then goes on to describe as a "typical insight" of Morrison the "determination" of this low ratio relative to atmospheric helium, in "samples taken from such places as hot springs," because of a He^3 source in the atmosphere from cosmic radiation.

Unfortunately for Bethe's illustrative example (but fortunately for those who delight in the continuing evidence that Earth still has secrets to reveal), it is fairly common, if not general, knowledge that the He^3/He^4 ratio in most hot springs is about seven times greater than in atmospheric helium; a very large isotopic enrichment indeed. In some hot springs (Yellowstone, Ethiopia, Iceland) the ratio is even more enriched, being 15 to 20 times greater than atmospheric. Like Kelvin's missing effect—radioactivity—the He^3 enrichment in hot springs (and in deep ocean water and oceanic basalts) is also due to an unexpected but very important effect: the fact that the interior of the Earth is still degassing primordial He^3 inherited during its original accumulation as a planet. The magnitude of this effect can be judged by the evidence of a huge deep-water He^3 -enriched plume in the South Pacific, which can be traced over 2000 km to the west of its origin (in submarine hot springs emitted at 350°C) on the crest of the East Pacific Rise [J. Lupton and H. Craig, *Science* **214**, 15, (1981)].

This further example of the "Kelvin effect" emphasizes the importance of checking deductions with experimental measurements; Aristotle was so convinced of his deduction that women have fewer teeth than men that he never looked in a woman's mouth. The helium-3 source has been known since 1969. Bethe should have limited (as did Morrison and Pine) the story to granitic rocks, but in his enthusiasm to extend the story he has provided an excellent cautionary tale.

H. CRAIG

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3/83

Rechargeable batteries

The major difficulty in utilizing beta alumina in a sodium sulfur battery (July 1982, page 46) is due to the formation of a sodium sulfide film between the beta alumina conductor and the cathode during discharge. Under ordinary operating conditions, this film acts as a barrier to the flow of ions and electrons. As the film thickens during discharge, the internal electrical resistance of the battery increases nonlinearly, due to a buildup of sodium ions at the beta alumina-sodium sulfide interface and of sulfide ions at the sodium sulfide-cathode interface.

If, on the other hand, this film did not form a contiguous phase between the

beta alumina, which conducts sodium ions, and the cathode, where sulfide ion formation occurs, or if instead it were removed as soon as it was formed by some clever physico-chemical process so that ionic and electronic flow could proceed unimpeded, the internal electrical resistance of the battery would remain relatively constant during the entire discharge process. If either were the case, the transformation of chemical energy into electrical energy could take place efficiently.

So far, efforts to achieve an efficient "rechargeable" battery, in which the reaction product forms as a solid between the beta alumina and the cathode, have been unsuccessful. The reason is, as experience suggests, that the concept is ill-conceived.

IRVING WARSHAWSKY
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Employment in physics

We differ with one of the conclusions of the article by Beverly Fearn Porter and Roman Czujko, entitled "Scientific employment in a tightening economy," in February (page 36). The statement in question is that the APS membership unemployment is only 1% which, we believe, is but only a part of the true employment picture.

As accurate as this statement may be, it is a very sensitive one because it can be quite misleading, and thus detrimental to the physics community. From it one may easily conclude that the employment picture for physicists is good. As the article later points out, only about 70% of the total APS membership are physicists. Furthermore, two facts are rarely mentioned in employment reports: First, a good many physicists were forced to leave physics to find employment and many of them have not kept up their membership, and second, of those employed as physicists, it is evident that many of the newer PhDs hold only temporary positions (postdocs, visiting faculty and laboratory positions, and non-tenure-track faculty positions); a fair portion of these may also find that they must leave physics to obtain stable employment. The point is that the employment scene for physicists is actually bleak.

Figure 8 of the article is a convincing proof of our contentions. The traditional physics fields are experiencing a net out-mobility of membership. The immobility of membership at best represents the versatility of physicists to adapt to changing employment conditions. Many of the fields with a net inflow of membership are not taught in physics departments. By this definition, and with no value judgment in mind, should they be thought of as being physics?

We find it especially disconcerting that in a publication put out by The American Physical Society more care is not taken in accurately stating the facts about the employment of physicists. We fully recognize that statistics can only be collected on active members. But, when displaying these statistics, qualifiers such as the points above should accompany them, and an effort should be made in quantifying these qualifiers. Uncritical reporting of such statistics is neither fair nor helpful in understanding the profound issue of un- and under-employed individuals trained in physics.

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3/83

THE AUTHORS COMMENT: Although Frank Madarasz and Frank Szmulowicz frequently refer to APS, it should be stressed that the article is based on all nine member societies of the American Institute of Physics, not just The American Physical Society.

As noted in the article, unemployment rates are a poor indicator of the employment opportunities for scientists and engineers. While under-employment is difficult to measure, we agree that we could have noted that among the physical and natural sciences, physics over the last 12 years, has exhibited the lowest retention rate of PhDs trained in the field. We also agree that the employment picture for PhD physicists seeking work in "traditional physics subfields" has been tight, especially so for university employment. However, physics as a field is changing in response to labor-market demands, and many individuals employed in applied or interdisciplinary areas are finding their work exciting. Although money is not everything, one must be impressed by the salary structure for society members employed in industry, which has rapidly become the dominant employer of recent physics PhDs. Thus, it is particularly difficult to agree with the statement that "the employment scene for physicists is actually bleak."

BEVERLY FEARN PORTER
ROMAN CZUJKO
American Institute of Physics
New York, New York
4/83

Correction

March, page 44—The bar chart showing the aggregate arsenals of the US and USSR shows incorrect dates for the arsenals. Both sets of left-hand bars, US and USSR, indicate the levels in 1972; both sets of right-hand bars, US and USSR, indicate the levels in 1982.