1968 by E. Migneco and J. P. Theobald[4] demonstrated the same dramatic grouping of resonance clusters in the neutron-induced fission of Pu^{240}. Subsequently, the effect was confirmed further in other non-fissile nuclei, such as U^{234} and U^{238}

The Np^{237} results, of which we were well aware but had accidentally transposed with the later Pu^{240} findings, should have been accorded their deserved precedence, and due credit should have been given to the above Saclay group. As Andre Michaudon is currently preparing an abridged version of the above ICINN Conference review paper for publication in PHYSICS TODAY, we hope that this timely correction may set the matter straight and apologize for any misconceptions that may have arisen.

References

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2. A. Michaudon, "Nuclear Fission," in Advances in Nuclear Physics, edited by M. Baranger and E. Vogt, Vol. 6, pages 1–217 (Plenum Press, New York and London, 1973): see pages 74–83.
3. "New Insight is Offered into the Fission Process," Search and Discovery, PHYSICS TODAY, Feb. 1969, pages 64–67.
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HERMAN FESHBACH
Massachusetts Institute of Technology
Cambridge, Mass.
ERIC SHELDON
University of Lowell
7/11/77 *Lowell, Mass.*

More physics in poetry

Further to the remarks of H. A. Klein (January, page 84) and V. F. Weisskopf (June 1976, page 23), your readers may be interested in a remarkable (if unwitting) anticipation of special relativity in Wagner's "Parsifal." In Act I, as Parsifal is led through a forest to the Hall of the Grail, he sings[1]

"Ich schreite kaum—doch wähn' ich mich schon weit."

To which Gurnemanz replies:

"Du siehst, mein Sohn, zum Raum wird hier die Zeit."

A literal translation is

"I pace hardly at all, nevertheless I feel I have come far already."

"You see, my son, that here time transforms into space."

This is not the "official" translation,[1] which is modified by the constraints of rhyme, meter and dramatic singing in English.

Why Wagner chose this phraseology is not at all clear. The idea does not appear in his medieval sources, and he gives no explanation in his own writings. The discussion by Paul Bekker,[2] although complicated, does explain what Wagner probably meant, although there is no clear agreement among the experts. The actual choice of words again may have been dictated by poetic requirements.

I find no indication in Einstein's biographies, nor in talking with several of his biographers and colleagues, that he was ever aware of these unusual lines. In fact, Einstein's tastes in music ran to more classic composers, and he apparently showed no interest at all in Wagner. Banesh Hoffman relates one story: he invited Einstein to join him at a performance of "Tristan and Isolde." Einstein declined, saying "They have died too often."

This passage in "Parsifal" was first called to my attention in a *son et lumiere* lecture by Edwin Land at John Hopkins' Rowland-Wood Symposium on 21 November 1975.

References

1. "Authentic Librettos of the Wagner Operas," Crown, New York (1938); page 445.
2. Bekker, "Richard Wagner, His Life in His Work," W. W. Norton, New York (1931); page 491.

ROLF M. SINCLAIR
National Science Foundation
6/13/77 *Washington, D.C.*

Origin of solar system

I am writing in reference to Grace Spruch's news story in your May issue (page 17) on the origin of the solar system directly from a supernova. I would like to point out that many years ago Fred Hoyle suggested that a solar system might arise from a binary star in which one of the components becomes a nova.[1] In 1971, I published my own theory of formation of solar systems from fragments of a supernova shell.[2] More recently, I have written a concise review of this model and its extension to the formation of galaxies.[3]

References

1. F. Hoyle, Mon. Nat. Roy. Astron. Soc. **105**, 175 (1945).
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WILBUR K. BROWN
Los Alamos Scientific Laboratory
6/6/77 *Los Alamos, New Mexico*

Optics today

In his review of our text, *Contemporary Optics for Scientists and Engineers* (May, page 74), Charles Frahm raised

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several questions about what subject matter should be included in an undergraduate course on optics. We think that these questions have a broad meaning for the physics community that transcends interest in a book review and would like to comment on them.

Numerous surveys conducted by the AIP and others in recent years have shown that there are fewer opportunities along traditional career paths today than in the past. It follows that if the present generation of physicists continues to be trained according to traditional procedures, it will be trained for increasingly non-existent careers.

A realization of this problem has prompted a great deal of discussion of alternate careers in applied areas. We submit that if physicists are to pursue alternate careers the nature of their education and training must be changed so as to enhance the prospects of their successful pursuit of these alternate paths. This cannot be done as an afterthought while keeping the structure and content of our courses unchanged.

There is an adage to the effect that "Generals spend time between wars learning to fight the past war better." What we must avoid is physicists spending time between technological cycles learning to contribute better to the past cycle.

The reviewer concluded that our book would make a fine text in an applied-optics course, but that a number of topics found in a traditional optics course were not covered. That is precisely the point! A book or course cannot include all of the traditional material and have room for modern applications other than by adding a few footnotes here and there or a brief section at the end. To meet today's needs there should be an emphasis on newer topics.

In addition to the proper selection and emphasis of topics the manner of presenting the material is important. We think that optics should not be taught by the *deductive method*—writing down Maxwell's equations and deriving expressions from them. Students tend to become immersed in vector algebra and do not learn how to apply their knowledge. The subject should be taught by the *inductive method*—the key experiments that form the basis of what we know should be reviewed. The fundamental properties of light waves and their interaction with matter should be built up one by one by reference to phenomena. This approach, particularly when associated with a laboratory, helps students develop an intuition for phenomena and this makes it easier for them to apply their knowledge to real-world problems.

In today's world, not only courses in applied optics, but also the standard undergraduate course in optics should be taught along the lines outlined above.

RICHARD A. PHILLIPS
Foster Grant Co., Inc.
Leominster, Massachusetts
ALLEN NUSSBAUM
University of Minnesota
7/25/77 *Minneapolis, Minnesota*

Commodity reserves

Recent letters have discussed known world reserves of several important energy-related commodities such as coal and uranium. The discussions often center on how long it will take for such reserves to be "used up," given various sets of assumptions. In this respect I thought your readers might be interested in the following table taken from the May 1977 issue of the Morgan Guaranty Survey.

This table shows that the known reserves of all but one of the eleven commodities listed actually *increased* in the period from 1950 to 1970, some by extraordinary amounts. Unfortunately coal and uranium are not listed. While it would be rash to conclude from this table that the more such commodities are used up, the more we still have, I think it is fair to say that predicting the "life expec-

Known world reserves—1950–1970

	1950	1970	Percent change
	Thousands of metric tons		
Iron	19 000 000	251 000 000	1 221
Manganese	500 000	635 000	27
Chromite	100 000	755 000	675
Tungsten	1 903	1 328	−30
Copper	100 000	279 000	179
Lead	40 000	86 000	115
Zinc	70 000	113 000	61
Tin	6 000	6 600	10
Bauxite	1 400 000	5 300 000	279
Potash	5 000 000	118 000 000	2 360
Phosphates	26 000 000	1 178 000 000	4 430