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and standoff distances to the off-site public. This composition is not a source term and does not correspond to the expected releases from a severe accident. Indeed the assessments that are made assume that only off-site releases, or source terms, that occur are from low-leakage paths and do not result in major health impacts. Most regulations require nuclear power plants to be designed, built and operated in such a way as to prevent releases and to retain any release that might occur, and the quoted composition is used to enforce those regulations. A severe accident is an event that surpasses the required capabilities of the plant.

Levi also cited the large "dose–conversion" factors of the refractory fission products, typified by lanthanum, as the reason the APS study group devoted especial attention to their potential release. This is not true, as the dose–conversion factors (the ionization densities in human tissue per curie of isotope) of the refractory elements are no larger than those of other fission products and much smaller than some iodine and strontium isotopes. The refractory elements deserve consideration simply because there is so much of them in the core inventory. As used in severe accident studies, the "lanthanum group" of refractory elements includes all elements having very stable refractory oxides, and 0.1% of this group is a much larger fraction of the mass and radioactivity of the core than 4% of the iodine. In addition, it is the dose received by the human thyroid gland as a result of inhaling and absorbing iodine that is of relative importance, and not the whole-body dose that was compared in Levi's excerpt.

Doses from noble-gas fission products can be received only from radiation emitted in the surrounding air, while the refractory oxides can deliver radiation from deposited aerosol particles inside and outside the body long after gaseous releases have diffused or blown away.

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Conceptual understanding

Lillian C. McDermott has considered some important problems in her article, "Research on conceptual understanding in mechanics" (July 1984, page 24).

I have argued (November 1983, page 111) that high-school pupils know neither Aristotle nor Newton but simply have the tendency to establish the relationship between the cause and effect. So the persistence of Aristotelian thinking is natural.

In case of the swinging pendulum, perceiving a force in the direction of motion is not surprising. On the contrary, it is consistent with our assumption that the unbalanced sine component of the weight (that is, $mg\sin\theta$) acts as the restoring force.

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'Physics News in 1984'

In his item, "Reconnection of Magnetic Field Lines," in "Physics News in 1984" (January, page S-50), N. C. Luhmann claims that "associated with the reconnection in both solar flares and magnetic substorms is a transfer of magnetic field energy into heating and directed particle energy."

This should be compared with the statement in a monograph authored[1] by Larry R. Lyons and Donald J. Williams: "It remains to be shown that field line interconnection can directly transfer energy from the magnetic field to charged particles (field line merging, reconnection) or that plasma turbulence effects are important as acceleration processes."

In my judgment, the Lyons and Williams version is the correct one. They could have safely added that this will never be shown because it is in conflict with elementary laws of physics. This is easily understood if we calculate the electric current (by taking the curl of the merging magnetic field) and depict the current system. This demonstrates that the transfer of field energy to the acceleration of particles is not a *local* process (except in special cases) but a *global* phenomenon, which makes it necessary to include the whole region where the current flows. (I have treated[2] this subject in my monograph *Cosmic Plasma* and in a number of papers.)

References

1. L. R. Lyons, D. J. Williams, *Quantitative Aspects of Magnetospheric Physics*, Reidel, Dordrecht, Holland (1984), p. 4.
2. H. Alfvén, *Cosmic Plasma*, Reidel, Dordrecht, Holland (1981).

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3/85 *San Diego, California*

THE AUTHOR REPLIES: The basis for Alfvén's disagreement with my article describing the elegant pioneering basic laboratory studies of R. L. Stenzel and W. Gekelman on magnetic field line reconnection processes appears to be based solely on the sentence that he

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quotes from the monograph by Larry R. Lyons and Donald J. Williams. I would suggest that he read the paper "Magnetic field line reconnection experiments and restivity, heating and energy flow" by Stenzel and his colleagues. Here the authors provide *quantitative* experimental measurements of the energy balance within the plasma during the reconnection process. They find that during reconnection more than 80% of the electromagnetic power input $-\nabla\cdot(\mathbf{E}\times\mathbf{H})$ is dissipated and goes into particle heating ($\mathbf{E}\cdot\mathbf{J}$) and particle acceleration, with the bulk appearing as heating. Here it should be noted that all of the terms were directly measured. I therefore conclude that while it may remain to be seen that stored magnetic field energy can be transferred to particles in space, it has certainly been observed in the laboratory.

Reference

1. L. R. Stenzel, *et al.*, J. Geophys. Res. **87**, 111 (1982).

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7/85

Serendipity

We are collecting data on:

▶ references in the literature to the role (however limited or extensive) of chance in the advance of science, engineering and technology

▶ personal experience of serendipity unrecorded, or incompletely referred to, in published papers.

We would be grateful for any well-documented information that readers can supply. Please send such material to Rustum Roy at 202 Materials Research Laboratory, Pennsylvania State University, University Park, PA 16802.

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SDI clarification

I wish to make sure that my remarks quoted in a July Washington Reports story (page 58) are not misinterpreted as a statement of support for the implementation of the Strategic Defense Initiative program. My position is that most of us need to await the data from The American Physical Society's study of directed-energy weapons before either condemning the project or advocating the expenditure of large sums of money on its behalf.

If people as knowledgeable as Nicolaas Bloembergen and C. Kumar N. Patel need more time to study the problem, it's hard to imagine how the rest of us can make an informed judgment simply by reading the newspapers.

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7/85

Correction

October—The cover painting is by Julius Paulsen. □

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