

ford Swartz. Although he reports that "the last of the [Physical Science Study Committee] workshops was held almost 20 years ago," the fact is that these, as well as Introductory Physical Science workshops, have been held in recent summers on the Colorado School of Mines campus and are planned to be continued in the future. More than 150 teachers have participated since 1986. Sponsored by CSM, the summer workshops are coordinated by Uri Haber-Schaim, an originator of both PSSC and IPS, and an exemplar of the persistence in "shaking the educational bedspring" that Swartz encourages in his article.

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10/91

SSC: Accelerator of Public Knowledge?

We read with great interest the letter from Daniel M. Smith of Austin (July 1991, page 84) in which he recommends that a substantial sum be "invested in educating interested persons around the world in the physics the SSC will elucidate." This is an exciting and far-reaching idea. Fortunately, the creators of the SSC project were similarly farsighted. "To create a major national and international educational resource" is in fact one of the two primary goals of the SSC. (The other goal is, of course, to create the world's premier high-energy physics laboratory.) The SSC is the first national laboratory to have education as a primary goal from its outset. Toward the promotion of this goal, the laboratory now has under way or under development a number of educational programs.

For example, this summer:

- ▷ Thirty-nine outstanding high school and undergraduate students are participating in our ten-week student intern program.
- ▷ Ten undergraduate and graduate co-op students from seven universities in Texas and New Mexico are working on other special projects at the lab.
- ▷ As part of a national Earthwatch expedition, five high school students from across the country examined environmental conditions at the future SSC site.
- ▷ Eleven minority students are working as technicians at the lab and will continue to work part-time during the school year, as long as they agree to stay in school.
- ▷ A team of junior high school teachers is working with scientists to develop curriculums and interactive software for grades 6 through 9 as part of

an initiative to expand the SSC's elementary-level Adopt-a-Magnet program to the junior high school level.

Teams of teachers also have developed and run pilot tests of supplemental materials to enrich the science curriculums for grades pre-kindergarten through 5. Support for these educational programs and many others in operation or under development is an integral part of the funding for the SSC.

Among virtually everyone here at the lab there is a strong commitment to using the uniqueness of the SSC to increase the understanding of science, mathematics and technology among the nation's students and teachers. Information on broad areas of science on a more basic level will also be provided to the general public.

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9/91

Past Science Teaching: A Textbook Case

The interesting issue of September 1991 on pre-college education prompted me to look more closely at several old textbooks I have collected. For comparison of subject matter and style probably the most interesting is by J. L. Comstock, MD. Published in New York in 1838, its title is *A System of Natural Philosophy: in which the Principles of Mechanics, Hydrostatics, Pneumatics, Acoustics, Optics, Astronomy, Electricity, Magnetism, Steam Engine, and Electromagnetism are Familiarly Explained*. It is "designed for the use of schools and academies."

Like many current science texts, this one defines a large number of terms, such as "brittleness," "ductility" and "tenacity." There are essentially no equations such as we now see in physics texts. Instead calculations are described by a "rule" (or recipe). For example, for falling bodies, instead of $y = \frac{1}{2}gt^2$, the rule is given as follows: "Reduce the time to seconds; take the square of the number of seconds in the time; and multiply the height through which the body falls in one second by that number." This is followed by several examples. Perhaps this kind of step-by-step explanation of a formula is a good way for a beginner to learn.

Large parts of the text explain the physics behind the operation of many everyday items. There is a long

section on simple machines (levers, wheel and axle, pulleys), center of gravity and pumps. Much of the chapter on optics, all geometrical optics, is similar to what one would find in a present text. The steam engine is covered in 15 pages, with complete descriptions of the Newcomen and Watt engines as well as the "double acting engine . . . of the present day." That section ends with the statement "The great number of accidents which have happened in this country . . . must be attributed in great measure to the eagerness of our countrymen to be transported from place to place with the greatest possible speed, all thought of safety being absorbed in this passion."

I found the section on astronomy (about 74 pages) to be much more extensive and detailed than is apparently the present norm. The author attempts to put sizes into the perspective of his readers. For example, "the distance of the sun from the earth is 95 millions of miles, and his [sic] diameter is estimated at 88 000 [sic] miles. . . . A traveller, who should go at a rate of 90 miles a day, would perform a journey of 33 000 miles in a year, and yet it would take such a traveller more than 80 years to go around the circumference of the sun. A body of such mighty dimensions, hanging on nothing, must have emanated from an Almighty power."

The text ends with a section on electromagnetics. The Oersted experiment was done only about 18 years before this publication, yet the book describes it in considerable detail. Even in that short time applications had developed that are also described, such as the electromagnet. The precursor of a motor is illustrated by a strong vertical bar magnet immersed in a cup of mercury, with a wire carrying a current dipped into the mercury. Then "the wire will revolve around the magnet with great rapidity."

In spite of much we might consider quaint, I feel that the author makes a point that is still worth considering in looking at the pre-college curriculum when he writes in the preface: "The author has also endeavored to illustrate the subjects as much as possible by means of common occurrences, or common things, and in this manner to bring philosophical truths as much as practicable within ordinary requirements. It is hoped, therefore, that the practical mechanic may take some useful hints concerning his business, from several parts of the work." We in higher education too often forget that many who do not continue beyond 12th grade find little in their

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courses that is of relevance to their "real world."

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10/91

Are Megaprojects Middle-Class Welfare?

Frankly, I was more than bothered by D. Allan Bromley's support for megaprojects in his interview with *PHYSICS TODAY* (October 1991, page 93); I was deeply disappointed by his cynical rationale for the waste of vital national resources. The issue is not one of immediate infrastructure benefits versus what he calls "investing in the future." It is one of strengthening our economy versus continuation of middle-class welfare programs that not only are of negligible scientific value but also misdirect our limited and steadily diminishing engineering and scientific manpower.

If the Pentagon can give up the Stealth bomber (which has already happened) and many missile programs (next on the agenda), then physicists should stop pretending that there is anything of value in the space station and the SSC. We should instead be thinking seriously about rehabilitating our educational program so that it can provide our young people with the kind of education that will be of value to them in the 21st century.

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11/91

Nature's Chirality: Why Not Evenhanded?

In their article "Handedness, Origin of Life and Evolution" (July 1991, page 33) Vladik A. Avetisov, Vitalii I. Goldanskii and Vladimir V. Kuz'min present arguments in support of the view that chiral asymmetry should have arisen before the evolution of life, but they do not address clearly the problem of why the handedness is uniform, that is, why there is homochirality in the entire biosphere. If a prebiotic symmetry breaking process is assumed to have occurred, why should this process have produced the same handedness everywhere and not produced some areas dominated by L amino acids and others dominated by D amino acids? If one looks at chiral symmetry breaking in crystallization of compounds such as NaClO_3 , for example, statistically equal numbers of L and D crystals are found. (Crys-

tals of NaClO_3 are optically active, though the molecules are not chiral.)

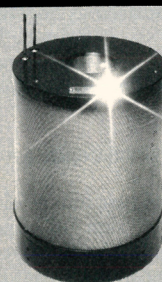
Much of the work in seeking systematic chiral asymmetries (the values Avetisov and his coauthors quote in the table on page 36 without references) is aimed at looking for mechanisms that produce homochirality. George Nelson and I pointed out that for reactions that occur in large volumes ($1 \text{ km} \times 1 \text{ km} \times 4 \text{ m}$) and on long time scales (tens of thousands of years) even a very small systematic effect can have a profound influence in producing dominance of the same handedness in every instance with virtual certainty (more than 98%). I also find Avetisov, Goldanskii and Kuz'min's description of our result inaccurate and misleading. For example, in describing the processes of state selection that we studied, they say that the region near the critical point

is particularly vulnerable to fluctuations as fluctuations grow near the critical point. As a result, the system can end up on the other branch. Therefore we feel that the requirements for "amplification" of the advantage factor in the vicinity of the critical point are contradictory: On the one hand, this region must be passed sufficiently slowly for the asymmetry to "accumulate." On the other hand, this region must be passed quickly enough to preclude the system from switching over to the opposite enantiomeric state.

The main point of our result is that as the critical parameter sweeps from a value below the critical point to a value above the critical point, the transition to an enantiomeric state becomes very sensitive to any small systematic bias; this sensitivity is due to a process similar to signal averaging that happens in the neighborhood of the critical point. Avetisov and his coauthors make no mention at all of the signal averaging process in which "accumulation" of a constant signal will eventually surpass "accumulation" due to random noise. There is nothing "contradictory" about this process. Our formula for the probability that the system will evolve to a particular state has been verified through many simulations under different conditions. I urge interested readers to read the references Avetisov and his coauthors cite and not to take their remarks at face value.

Also, a minor technical error in the article is the statement that all L amino acids are levorotatory. The designation "L" refers to the absolute geometric configuration and not the

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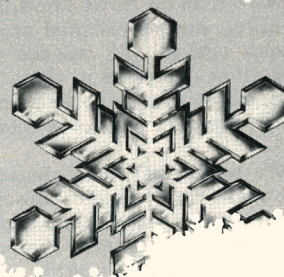
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