

boards be pressured into making accuracy of texts a requirement for adoption. Although theoretically those would appear to be steps in the right direction, there are pitfalls and problems.

In more than 20 years of speaking at teachers' conventions and writing a column in *The Physics Teacher* discussing errors in textbooks, I have often been surprised by the large number of college teachers and scientists listed as authors or consultants in books that have many errors. Having scientists' names on the books seems to relieve the editors of the need to make real efforts to remove erroneous material, since they can claim apparent approval by the experts. Also, textbook selection committees, which usually have no way to evaluate accuracy, feel assured that the books are accurate when they see familiar names and impressive credentials listed. However, it is not safe to assume accuracy based on the involvement of experts, for a number of reasons.

The scientists, as authors or consultants, have little control over what is ultimately published. The editors have the last word and often cannot be persuaded to use the scientist's version of material they consider controversial; they are reluctant to change books that have sold in the past. Or the scientists are consulted only on a few details rather than having a general advisory role for the total publication.

Perhaps because of the perceived audience, many scientist-authors don't give their writing adequate thought. They don't seem to realize that special care is required to write for an audience with little background and that it is generally not easier than writing for fellow professionals.

Having been a consultant on a number of books for a number of publishers, I have learned to appreciate the difficulties that publishers have in finding authors, proofreaders and consultants who are knowledgeable, careful and willing to spend the necessary time on their tasks.

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7/92

The letter by Jay M. Pasachoff prompts me to write about a common error in texts on modern physics. The problem concerns the interpretation of the famous experiment by Clinton Davisson and Lester Germer. Just as Lawrence Bragg had measured x-ray wavelengths with crystal gratings, Davisson and Germer were attempt-

ing to use crystals to measure the wavelength of the electron—a new idea due to Louis de Broglie but foreshadowed by Niels Bohr's atomic theory. However, as Arnold Sommerfeld later noted, the theory underlying the experiment "at that time was still in quite an unsatisfactory state."¹ Davisson and Germer assumed considerable penetration of the electron into the crystal and so used the Bragg law to describe their results. In fact the electron-lattice interaction at the energies of the experiment is so great that it is the two-dimensional surface net that determines the angular disposition of the spots in the diffraction pattern.² As well as being correct, an approach based on this fact leads to a simpler analysis of the Davisson-Germer results than the original. It appears that most authors of modern physics texts have returned to the original article by Davisson and Germer for both experiment and interpretation. Of six modern physics texts on my bookshelf, only that by Robert L. Sproull and W. Andrew Phillips³ has a correct discussion of the Davisson-Germer results.

References

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High School Teachers Need College Contact

I was delighted to read Peter Lindenfeld's Opinion column "The Lonely Physics Teacher" (July 1992, page 63). Lindenfeld addresses a problem of which I have been aware for some time and makes his points clearly and strongly.

As a high school physics teacher who immigrated to the US from the European system, I have been frustrated by the lack of information flow between university physics teachers and high school physics teachers. Whenever I have asked a university teacher what background would be desirable for an incoming student, the answer has invariably been, "Nothing; we start at the beginning our own way."

At meetings and conferences concerning the Advanced Placement Physics curriculum there is an expect-

tation that high school students can absorb in two years all the physics they need to know to progress to sophomore standing when they enter college. I am trying to provide enough training for my top ten college-bound seniors to bridge the gap between eighth grade and college freshman physics in 40 weeks of their already crammed-full senior year. To set an achievable goal for that year, with sufficiently challenging material, I prepare them for the College Board's AP "B" paper in those 40 weeks—a course increasingly adopted by many of my peers at other schools. Actually I have only 35 weeks, since the AP exams are in the middle of May. It creates tremendous pressure for the teacher and the students.

I am in the fortunate position of being in close contact with faculty members at some small local colleges and some reasonably close larger universities, with whom I have had useful and supportive interactions. However, the college-level physics education establishment is not as supportive of high school teachers as the chemistry education establishment has been for many years.

My needs from the wider physics community are several, but the most urgent are:

▷ A more realistic curriculum for a one-year course for college-bound students that will be recognized as appropriate by the larger universities.

▷ More standardization of text material across the nation, with consequent standardization of the colleges' expectations of what the incoming freshman has studied in high school. Too many textbooks range from introductory to sophisticated in one course and then expect the student to carry and care for a 500-page book each day.

▷ Closer identification between college teachers of physics and high school teachers of physics, or in Lindenfeld's words, a less "remote, obscure [and] patronizing" stance on the part of the college teachers. The prevailing stance is particularly evident in the many journal articles that advocate classroom demonstrations that are ideal for the teacher with a full workshop in a garage or prep room and with the technical training to do a neat soldering job or skilled woodworking.

As one of the many women teaching physics, with limited technical training, without a fully equipped shop at my disposal, with a limited budget to purchase new demonstration equipment to meet ever changing course requirements and with family commitments outside of school hours, I look forward to more attempts like

Lindenfeld's to look at the real problems of science education today.

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Shockley's Scientific Standards Defended

May one rise, even in these politically correct times, to defend the late Nobel laureate William Shockley? It was depressing to read the letter from William Spence (February 1992, page 124) attacking Shockley's obituarists (June 1991, page 130) for failure to include a ritual denunciation of Shockley's "many years and tremendous effort" devoted to his "appalling ideas" on race and intelligence. Is it the task of obituarists to do this when the man can no longer defend himself?

Spence complains that Shockley's "arguments were repeated in public over a period of at least ten years" and that "Shockley's views had much in common with those of Arthur Jensen, Hans Eysenck and Cyril Burt (later found to have faked his results), all of whom he cited and corresponded with." This clever wording stains Shockley, Jensen and Eysenck with guilt by association with Burt. And in Spence's view, it seems, Shockley's real thoughtcrime was that he worked seriously on his ideas, spoke publicly about them, and cited and corresponded with other workers. Are we to infer that had Shockley instead been flighty and scatterbrained about his ideas, kept them to himself or failed to cite other workers, Spence might have forgiven him his sin?

The vilification of William Shockley was not a proud chapter in the history of social science. Fifty eminent colleagues who defended his right to speak found that they too came under attack.¹ Must this continue beyond the grave? People's views on such matters are often determined by sociopolitical fashion more than by evidence,² and discussions quickly become polemical. That is why most of us stick to physics. Shockley's contributions in physics will endure, and his obituarists were right to dwell on them.

References

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 2. W. B. Provine, *Science* **182**, 790 (1973).
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SPENCE REPLIES: James E. Felten's

defense of William Shockley misses my point entirely. Shockley evidently considered his eugenics arguments and investigations a significant part of his life's work. Given this, I believe that his obituarists were deficient in not apprising readers as to the nature of his beliefs. My letter was an attempt to redress that imbalance. I invite readers to discover for themselves the nature of Shockley's views on race, sex, class and so forth. I think most will find his opinions prejudiced and abhorrent. The research that he quoted was simply bad science, involving methodological errors and systematic bias. Again, readers should judge this for themselves on the basis of the available evidence. Reactionaries usually attempt to justify the inequalities, prejudice and systematic oppression in our world by invoking "scientific studies," which invariably conclude that these inequalities are based on irremediable group differences. While the refutation of such theories has been and can only be scientifically based, we should understand that the reason these theories keep arising is that there are vested political interests that promote them. Shockley was an enthusiastic participant in such endeavors, and the measure of his life must take account of this fact.

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2/93

India's Long History of Women of Science

In a very interesting and important article on women in science in *PHYSICS TODAY* some years ago (February 1980, page 32), Vera Kistiakowsky, going back to the prehistory of science, gave a list of women natural philosophers as evidence that women did participate actively in the study of natural philosophy and mathematics in that period. Kistiakowsky, however, confined herself to the European history. It might interest readers to know that quite a few Indian women natural philosophers and scholars who flourished during the same period could be added to the list.

During the Vedic period (approximately 2000 to 400 BC) there were as many as 20 women among the "seers," or authors, of the *Rigveda*, the oldest literary monument of the Indo-European languages, which constitutes one of the greatest sources of insight into not only early Indian mythology and rituals but also the political and social development of the time. In the fourth century BC

the admission of women to the Buddhist order gave a great impetus to the cause of women's education, especially among ladies of rich and aristocratic families. However, women's education began to suffer a great deal as early as 300 BC due to the new practice of child marriage. By 900–1000 AD women's education was confined to rich families, of which there were very few. These women were educated mostly by private tutors. Thus the number of women pursuing academic careers became virtually negligible. Therefore the beginning of the scientific age not only "coincided with a wave of opposition to the education of women in Europe and Great Britain," as Kistiakowsky noted, but coincided with a total ban on the education of Indian women.

Science and mathematics education as we know it today emerged at the beginning of the 17th century, but educational facilities for women began to improve only in the latter part of the last century. Though today all educational facilities and opportunities are open to women, statistics collected from all over the world indicate that the number of women participating in science and mathematics is very low. The *Science and Technology Pocket Data Book* (published by the Department of Science and Technology, Government of India, in 1989), which classifies science and technology personnel by field of specialization and sex for the year 1981, reveals that in India too the percentage of women scientists and mathematicians is very low. This is particularly evident in the mathematical sciences, where the number of men was circa 71 000 and women represented only 18 000. In 1984 the Indian National Science Academy had 700 male members and only 8 female members. Not much changed in the following six years: In 1990 there were 609 male members and 12 female members of the academy. In 1991, at a national program at the Indian Institute of Science training a team of 34 students to participate in the International Mathematical Olympiad, I found only two girls among the candidates for the team.

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Correction

March, page 50—The caption to figure 6 should have stated that the sequence at *right* was calculated by a conventional pseudospectral method and the sequence at *left* by contour surgery. ■