

(page 43), noted by Peter Lee (September, page 13), Lee's translation of the characters in the photo is not correct; the characters mean "extra limited-expresses," announcing a special schedule of the railway during a definite period.

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THE AUTHOR COMMENTS: The first two of the Chinese characters ("Kanji" in Japanese) actually mean "temporary," the third means "special," and the fourth means "urgent" or "express." I could not have guessed that the four characters put together constituted a time-schedule notice for limited express trains. My sincere thanks to Tatsuo Tabata for pointed out my error, and especially for reminding me that a Japanese Kanji does not always have the same meaning in Chinese.

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Role of the teacher

The article by Robert Fuller in September (page 43) illustrates a serious problem in physics education. Fuller cites a study in which students were asked (among other questions) for the trajectory of an object dropped from a moving airplane; many students responded that the object would fall straight down, rather than giving the "correct" answer, which assumes that the object would maintain the horizontal component of velocity of the airplane. Fuller then concludes that "The mind of today's student is... a jungle of... false ideas," which the teacher should have the students "unlearn."

In fact, under reasonable assumptions about the airplane's speed and altitude and about the aerodynamic properties of the falling object, the students' answer that the object would fall straight down can be much more nearly correct than the answer Fuller wants. However, my purpose is not to accuse Fuller of a physics mistake—I do not suppose that he seriously believes that one should neglect the effects of the atmosphere on a small object traveling at hundreds of miles per hour—but rather to point out that he displays a disparaging attitude toward students which, in my opinion, can make education impossible. It is my belief that the ideas students bring with them to the classroom can furnish a firm starting point from which to develop an understanding of physics. Of course, these ideas tend to be vague and unsystematic; it is the role of the teacher to lead the student to understand how ideas generated by everyday experience can be extended, and then

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letters

abstracted from, so as to arrive at the laws of physics. But never, it seems to me, should the laws of physics be presented as being in conflict with everyday experience.

If, as physics teachers, we insist that our students uncritically accept whatever we tell them, even when it contradicts what they already know to be true, then perhaps we will see the answers we want repeated back to us on examinations, but our students will simply not believe us. I have seen too many products of this kind of miseducation: students who have completely mastered the classroom version of Newton's second law—which states "If asked on an exam for the force, you can get a good grade by multiplying the mass times the acceleration"—but who have no idea that this law is supposed to govern the behavior of any real objects, outside of the classroom.

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THE AUTHOR COMMENTS: I used to share Jerry Finkelstein's benevolent naturalist beliefs about students' ideas. Then I began to interview students about physical systems and read the educational research of other physicists. Upon reflection it is not surprising that physicists can see in many everyday events the working of the laws of physics. But for the non-physicist, the invisible influences give visible events the appearance of contradicting the laws of physics. The unobserved factors of friction or gravity or motion of the observer give rise to false concepts of physics (for example, many students may have seen old war movies showing bombs dropping vertically down out of the open bomb-bay doors of airplanes; can that explain their preference for vertical motion of objects dropped from airplanes?)

The laws of physics do appear to be in conflict with everyday events. Surely that is why it has taken hundreds of years to formulate these laws and required geniuses such as Newton and Einstein to construct them.

This apparent conflict between "seen" and "unseen" physics is what makes our discipline such an excellent teaching medium. Students can develop mature reasoning skills if teaching provides experiences that promote cognitive conflict. A discussion of this technique is presented by J. L. Phillips Jr in his article "Do students think as we do? Progress with Piaget," *Improving College and University Teaching* 30, 154 (1982).

Our teaching task is not to construct the towers of physical law upon a foundation of sand provided by students' intuitive ideas of nature. Rath-

er, by confronting the students with experiences that contradict their expectations, they can be encouraged to construct new mental houses upon the rock of physics.

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1/83

Improving refereeing

As both a dealer in and recipient of good and bad reviewing, I am in full sympathy with the guest comment by Curtis Michel in December (page 9). A major problem in being refereed is indeed the frequent failure of the referee to respond in any depth to the author's rebuttal to the first round of criticism. Who has not experienced the exasperation and frustration of an all-too-frequent scenario: The first review is replete with misconceptions and misstatements about its content; a detailed and time-consuming response to the points raised fails to move the first referee; seeing a basic or nonbasic disagreement, the editor sends the manuscript to a second referee; and the process starts again at square one.

While some of the difficulty would be alleviated by an assistant editor who was conversant with the subject, I suggest that much of the problem arises from a lack of thought by the editor as to the role of the referee and of instructions or guidelines which would focus his analysis and simplify and improve his refereeing.

A case in point is a recent appeal by a colleague to the editor-in-chief of one of our top journals. The paper was indeed complicated, though possibly profound, and none of the referees had perceived the heart of the contribution. Its style did not appeal to them, and the criticisms bore more on tone than on essentials. The final appeal was dealt with as in a court of review; the basis of the disposition was that all appropriate steps had been taken, meaning referral to the proper number of referees and certification of their qualifications. The lack of any response of the referees to the detailed rebuttal of the author, the lack of statement at any point during the lengthy refereeing as to the acceptability or unacceptability of the article, or of what improvement would make it useful, were not germane. The article was rejected for no specific reason, condemned for crimes not given in any intelligible bill of particulars.

When asked the purpose of review, the editor-in-chief replied, "The present (and past) system, while never specifically defined down to chapter and verse, relies entirely on the honorable behavior of honorable individuals to a single end: to 'perfect' papers to make them of optimal utility to readers

of our journals." Of course—but has the editor no suggestion as to how the referee can help achieve this end?

After many years of reviewing, it dawned on me that I didn't really know my role in the editorial process, and so I worked out the following set of instructions to the referee to codify my thinking:

► The referee has a central position in our editorial process, and the quality of the journal hinges on the quality of the reviewing.

► Your task is to assure that the original contribution of the paper is as comprehensible as possible. This imposes on you the dual responsibility of assisting both the editor and the author.

► Because your sole contact with them is a written report, you should make it both informative and explicit. The report should be specific about the action to be taken by the editor and the improvements that will qualify the paper for publication. Avoid confidential remarks to the editor, as they hide information relevant to the future plans of the author.

► A detailed report to the author is important. As most papers are accepted eventually, it should concentrate on the clarity of the manuscript. How can the message of the paper be made more intelligible to workers in the field and to those with less concentrated interest? Typically, the report should include three types of review: a general impression showing your opinion as to which parts are important because of such points as their originality, their timeliness, or their clarification of confusing issues; a page-by-page notation of shortcomings or corrections of logic, fact, or presentation, with close attention to the completeness of the empirical data and to the pertinence of the figures and tables; and an unambiguous list of required changes and suggestions.

► Don't be caustic; exasperating the author only impedes the processing. As a qualified referee, you are probably deep in the subject and have strong opinions. Remember that the author, too, is a dedicated worker trying to advance the subject. Don't convey the impression that you feel your predilection is the final word or that science is revealed knowledge. A final reading of your review, focused on the probable reaction of the author, will often disclose an unexpected harshness whose removal will smooth the road for all concerned.

Feeling that these instructions might make a contribution, I sent them to the editor of one of the engineering journals. I have yet to receive a referee's report, and rather than burn them, I am offering them here. Perhaps they will stimulate others at the working