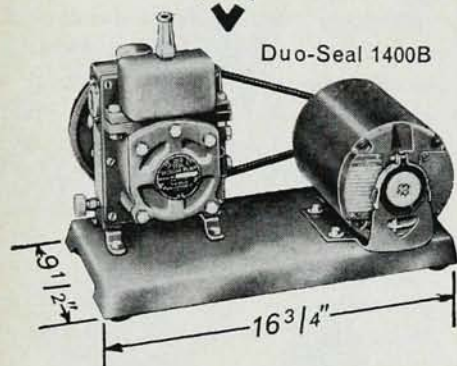


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LETTERS

(Continued)

seem to have felt) that virtually every business detail or proposal be subjected to popular referendum.

As the council has apparently recognized, the time is ripe to bring the constitution and bylaws into line with the increasingly difficult problems that have arisen from the present complexity and explosive growth of the society. The modernization of the society and its future progress will be best served if the dissidents decide to bury the hatchet for a while and join the rest of the members in giving the present proposals unprejudiced consideration and a fair chance to demonstrate their effectiveness.

John Rehner Jr

Esso Research and Engineering Co

Toughness of physics

May I comment on the editorial in the April PHYSICS TODAY on the difficulty of academic physics?

First, must physics be highly mathematical? Surely we can distinguish three aspects: there are qualitative physics, metrical physics and critical physics. Qualitative physics might be called (a part of) "natural history": it is the collection of information about nature. Metrical physics begins when we measure things and thus get numbers among which we seek relations. Critical physics is the examination of the notions involved.

Now the second two must presuppose qualitative physics; without it, without a good qualitative acquaintance with the phenomena, metrical physics is merely mathematics enlivened by quaint little stories, and critical physics is utterly futile. So it would seem reasonable to start with the qualitative aspect. There is another good reason for this: young people are good at collecting information before they are particularly good at mathematics and long before they are good at critical discussion. Moreover, mathematical work done early is done in a laborious way whereas if deferred a little it could be done much more efficiently. (Compare mechanics before and after calculus.) So it would seem reasonable to concen-

trate on the qualitative parts first, and these are, indeed, the only parts of interest to those who are not to become specialists.

From what I have just said, there would be good reason for starting the metrical part at the same time as, or a little after, calculus is begun. This part would be of interest especially to specialists and engineers. Even here things might be improved. The engineer's interest is in design, and the applied physicist at metrical work is acting as an engineer. Now problems in design are not specified very well and have no unique answers; in fact, they are quite different from the problems that students work by the hundreds in introductory courses. We should inquire, in fact, whether the kind of metrical work done in early courses may not be to the disadvantage of students whose ability might be in design but not in the solving of conundrums.

Critical physics is little taught, except some somewhat half-hearted attempts at "philosophy of science," which are rarely useful, because the physical tail always wags the philosophical dog. Anyone wishing to see what might be done in this part of physics might well read—starting without prejudice—Aristotle's *Physics*.

Experiments in the laboratory are needed especially for the metrical aspects—thus are not really necessary for the earlier parts. If done, they should aim at getting premises, such as Newton's laws, from which conclusions can be drawn. But to try by experiments to find a logical conclusion, such as conservation of momentum, is like solemnly measuring the square on the hypotenuse. Nor is it easy to see what students gain especially at the earlier stages, by spending an afternoon measuring something, say g , and then, having a result, falling down and worshipping it because it is good to five significant figures.

As for the attitude of "getting tough with them," the best possible comment on that was made long ago, and can be found in St Luke xi, 46: "Ye lade men with burdens grievous to be borne, and ye yourselves touch not the burden."

H. L. Armstrong

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