

letters

this third sense, a rubber band is more "elastic" than a steel wire because it is easier to stretch and will stand a proportionately greater elongation), in addition to the more general sense of (4) the property of returning to original dimensions after distortion. Why do these conflicting senses cause no problem and evoke no impassioned letters to physics journals? Simple! With no conscious effort by anyone, *elasticity* as the name of a *quantity* has quietly disappeared from our technical vocabulary: if elastic modulus (sense 1) is meant, one specifies shear modulus, bulk modulus, or whatever, as needed for the occasion; and "73% elasticity" in the context of partially elastic collisions refers unambiguously to sense 2.

With these examples to give perspective and to sharpen our concepts, we now come to the word *weight*. As in the examples noted above, there is no confusion with the nontechnical senses. The trouble is that the word refers to heaviness without any concern about whether its quantitative expression is m or mg . After all, the word had already been current for centuries before Newton said " $F = ma$." Thus weight has two intrinsically different technical senses, and this double meaning is what causes all the confusion.

Confusion? What confusion?! Physicists and engineers—and others who understand $F = ma$ and the need for consistent units—have no problem in selecting m or mg as needed for the problem in hand. In the English System, saying that a body "weighs" 16 lb does not in the least specify whether the problem is to be solved with pounds force and slugs or with pounds mass and poundals; and in SI units, the weight is stated in kilograms even though newtons are required when the gravitational force enters the problem. So the only ones confused are the least able Physics I students—and their confusion comes much less from the double technical sense of the word *weight* than from their lack of understanding of $F = ma$. Surely this is inadequate to occasion the longstanding dispute.

As seen from the above examples of words with multiple technical senses, any genuinely confusing ones soon fall out of technical use. Thus the *continuing use of weight in technical discussions shows that this is harmless and useful for most purposes*. Weight in its ambiguous sense of either m or mg becomes awkward only in definitions, in sharp distinctions, in close association with mathematical expressions, and in other explicit formal statements. For example, the statement that "weight means either m or mg " is fine if one is willing to speak algebra.

But though m is readily replaced by the compact word "mass" when one wants to speak English (that is, there is no need to beat about the bush with some such phrase as "inertial property"), the only adequate synonyms for mg have been "gravitational force" (2 words, 6 syllables, 18 letters) or "gravitational attraction" (2, 8, 23) or "force of gravitational attraction" (4, 10, 30)! Though these circumlocutions say exactly what is meant, they have the feel of using a meat axe to kill a spider.

So why hasn't the awkwardness been resolved by officially ruling that, in the technical context of mechanics, weight is mg , not m ? It isn't for lack of trying! For example, such a ruling was made in the 1901 declaration of the General Conference on Weights and Measures; physics texts have long been unanimous on the point, and as recently as 29 January 1979 to 26 January 1982 the American Association of Physics Teachers censured National Bureau of Standards publications that accept the occasional use of weight as a synonym for mass. But the problem remains unresolved as of December 1982 with the Thomson and Goldman letters; objects are still "weighed" on a beam balance or a grocery scale (honest "weight," no springs) to determine *mass*. Why?! The reason is that *weight* is a long-established and widely used word that belongs to all speakers of English; a dictionary reflects their current usage of the word. Thus if some scientific, technical, or governmental body presumes to legislate a *technical sense that clashes with the everyday dictionary sense*, it can expect to be ignored even (most of the time) by most members of the profession(s) concerned, as illustrated by the long and futile rumpus over the use of the word *weight*. In fact, I doubt that even the US Congress has the Constitutional authority to legislate such matters (especially not for other English-speaking countries); and certainly I can't imagine that it would want to bite off such a can of worms—not even to provide an occasion for this lovely mixed metaphor. So what needs to be done?

What is wanted is a good monosyllabic Anglo-Saxon word that means mg and not m . Fortunately, such a word with exactly the right meaning exists. The noun *heft* (like the related verb *to heft*) derives from the verb *to heave*. It is the weight of a body, explicitly as measured by the force to lift it. Thus the proposed technical definition $heft = mg$ is completely compatible with the ordinary dictionary senses. The fact that *heft* has largely fallen out of everyday use makes it all the more suitable for adoption in a specialized technical sense. The purpose of the foregoing argument is to suggest that

the appropriate committees representing American physicists should consult with the appropriate governmental and international agencies to adopt *heft* as the explicit technical word for mg —to be used at least (and perhaps almost exclusively) in the explicit formal statements mentioned above. But in less demanding discussions (even technical ones in mechanics) we should be free to continue to use *weight* casually in its widely useful everyday senses of *heaviness*, as expressed partially by either the mass m or the *heft* mg , and a *heavy object*, such as a paperweight or a calibrated 20-gram weight.

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Superconducting electronics

With reference to Theodore Hartwig's letter (March, page 102), I would like to note that the International Cryogenic Materials Conference to be held in Colorado Springs, 15–19 August 1983, will also feature another event of interest to solid-state physicists. The program for 18 August includes a one-day symposium on Materials and Processing for Superconducting Electronics that is devoted to refractory superconducting films and artificial tunneling barriers. The plenary paper by M. R. Beasley from Stanford University will be followed by sessions on Josephson tunnel junctions, films, barriers, film surfaces and interfaces. The detailed program of the symposium is available from me.

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Pseudo-QCD

In the news story, "A look at the future of particle physics" (January, page 19), many predictions of the standard model, claimed testable in present and future accelerators, are reported to have come out of two high-energy physics conferences during 1982. It should be pointed out that many of the predictions about the strong interactions are not honest predictions of the theory, since quantum chromodynamics (QCD), the component of the standard model essential to describe strong interaction dynamics, is still far from being solved. The problem arises from the fact that the perturbative part of QCD, which is calculable, only describes the behavior of quarks and gluons but not the behavior of hadrons; a prescription of how quarks and gluons turn into hadrons (called "hadronization") becomes necessary to predict observations. Many so-called pre-