

evidence that indicates the existence of conformational substates of proteins included Mössbauer spectroscopy, temperature-derivative spectroscopy, and laser optical hole burning. However, the use of another spectroscopic technique that also early on suggested the existence of distributions of energy sites was apparently omitted.

We showed the technique of fluorescence-line-narrowing spectroscopy, traditionally applied to small organic molecule systems, to be an effective tool in revealing the vibronic structure concealed in the inhomogeneously broadened absorption and emission lines of chromophores in intact protein matrices.¹ In FLN, using a combination of low temperatures (4 K) and narrowband excitation (less than 1 cm⁻¹), a subset of molecules whose transition energies are isoenergetic with the laser are excited. Given favorable conditions of weak "lattice" coupling, the emission spectrum is a quasi-line spectrum composed of zero phonon lines and phonon wings,² with linewidths for the former on the order of the laser linewidth.

FLN has afforded the opportunity to probe both ground- and excited-state vibrational structure and has been used to characterize fluorescent derivatives of electron-transfer and oxygen-transport proteins.³

Not only can FLN glean vibrational information, but it can also be used to monitor chromophore-protein interactions. If one follows an emission line as a function of excitation frequency, one obtains a distribution of emission intensity. This population distribution reflects the true distribution of zero phonon lines, and in a simple way, the width of the distribution is a measure of local disorder of the chromophore in the protein matrix.⁴ We have consistently found distribution widths of 30–60 cm⁻¹—values straddling those for crystalline systems (less than 1 cm⁻¹) and for true amorphous glasses (greater than 200 cm⁻¹).

Within the framework of the Frauenfelder and Wolynes article, we attribute this distribution to conformational substates of the molecule. The population distribution has been used to probe structural changes of the protein, within the vicinity of the chromophore, as a function of various modifications, such as changes in solvent ionic strength and substrate binding.⁵

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Weaponers Need Nukes; World Peace Doesn't

In his plea for the retention of the nuclear weapons competence of research establishments like Los Alamos and Livermore (May 1994, page 13) Joseph J. Devaney uses worn-out and discredited arguments. A similar plea could have come from the Chelyabinsk and Arzamas laboratories. It escaped Devaney that the threat to civilization that arose from the very work in these establishments necessitated a new approach to the problems of national and global security.

Nuclear weapons cannot be disinvented, but it is a non sequitur to say that they have to be kept and continually updated. It is a hallmark of a civilized society that it can control—by national laws or international treaties—the dangerous products of science and technology. The recent Chemical Weapons Convention—signed by 158 states—has knocked on the head the "disinvention" argument. Chemical weapons can be "reinvented" much more easily than nuclear ones, yet agreement has been reached on a complete ban and on steps to make the ban effective. There is no reason why the same could not be done with nuclear weapons.

Devaney quotes the old Roman dictum "*Si vis pacem, para bellum*" ("If you want peace, prepare for war"). But the whole course of history has shown that preparation for war results in war. Nowadays, even preparation for war has become too costly and is unsustainable. The nuclear arms race that raged for four decades (1949–89) could not have gone on much longer; it is likely that a nuclear holocaust would have resulted if an irrational hard-liner had come to power in the Soviet Union instead of Mikhail Gorbachev.

At no time during the whole pe-

riod was either side satisfied with what it had in its arsenals; both sides had to keep on modernizing their weapons or developing new defense systems. To a large extent the momentum of the arms race was generated by the scientists in the research establishments.

Thus Lord Zuckerman, for many years scientific adviser to the British government, wrote: "In the nuclear world of today the military chiefs . . . as a rule merely serve as the channel through which the men in the laboratories transmit their views. For it is the man in the laboratory . . . who at the start proposes that for this or that reason it would be useful to improve an old or devise a new warhead. . . . It is he, the technician, not the commander in the field, who starts the process of formulating the so-called military need."¹

The motivation of these scientists was explained by Herbert York, former director of the Livermore Laboratory: "The various individual promoters of the arms race are stimulated sometimes by patriotic zeal, sometimes by a desire to go along with the gang, sometimes by crass opportunism. . . . Some have been lured by the siren call of rapid advancement, personal recognition, and unlimited opportunity, and some have sought out and even made up problems to fit the solutions they have spent most of their lives discovering and developing."²

By a stroke of luck we have now a real prospect of putting an end to the obscene arms race. Let us make sure that this aberration of science is also brought to an end. The sooner these establishments are closed down or converted to peaceful work, the better the chance of our civilization's surviving in the nuclear age.

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Joseph J. Devaney's well-reasoned apologia for maintaining a high nuclear-deterrence capability is understandable in that anyone who makes a living through weaponry wants to remain employed. But he weakens his case by quoting the fatuous aphorism of the fourth-century military writer Vegetius: "If you want peace, prepare for war." And if you want

war, you obviously prepare for war. Kind of shuts off other approaches, doesn't it?

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'Rule of Thumb' Objection Overruled

The February 1994 issue of PHYSICS TODAY (page 126) includes a letter by Jack Straton complaining about the term "rule of thumb." Straton claims that the term derives from the size of switches with which men were permitted to whip their wives up to at least the first quarter of the 19th century and therefore it ought never to be used again. He mentions the writings of several authors on wife beating as if they were pertinent, but none of them provides evidence to support his thesis about the origin of "rule of thumb."

Now, I'm opposed to beating wives (and spinsters and husbands and bachelors and children and dogs and cats and parakeets, for that matter). I'm also opposed to inventing data to make a point, and Straton's argument is pure invention. There's no way to tell, of course, whether he is the inventor or a dupe of someone else.

Dictionaries reflect historical usage. The unabridged *Merriam-Webster Third New International Dictionary* doesn't mention Straton's novel definition and etymology. Neither does the second edition. Neither does the unabridged *Random House Dictionary of the English Language*. Neither does Eric Partridge's exhaustive *Dictionary of Slang and Unconventional English*. Neither does Harold Wentworth and Stuart Berg Flexner's *Dictionary of American Slang* or Brewer's *Dictionary of Phrase and Fable* or the *Morris Dictionary of Word and Phrase Origins* or Nigel Rees's *Why Do We Say . . . ?* or any of a dozen similar books I've checked, dating back to 1835.

Neither does the *Oxford English Dictionary* (or its *Supplement*), although it does cite a number of instances of the phrase's use. The first appeared in 1692. All of them hold the meaning we commonly employ today.

In *The American Language*, H. L. Mencken, a respected philologist and lexicographer among other things, warned us to beware of folk etymologies. No matter how intuitively correct an assumed relation between words may feel, it's usually wrong. Only careful historical investigation is likely to determine the accuracy of such relations.

Mencken was as concerned about other forms of ignorance as he was about ignorance of language. In *A Book of Prefaces*, he mentioned "the virulence of the national appetite for bogus revelation." Putting the best face on the matter, Straton seems to have fallen victim to this appetite. A wicked side effect is that, by getting his letter published, he stands a good chance of whetting someone else's as well.

But that's not the main reason I'm writing.

Pretend for a moment that Straton is right and that "rule of thumb" actually had that odd meaning in the early 1800s. His thesis is that words can only be used the way they were when they entered the language. But languages change. Words lose meanings, add meanings, change meanings. If we let the Stratons of the world constrain us, how could we discuss "spins" or "strings" or "beauty"? The idea that each term we use can be used only one way is absurd. It is abhorrent. It is irrational.

Straton's rule of word use would destroy the richness of English. It would tie meanings forever to etymological origins.

If Straton insists on being politically correct, let him start by being correct. But even if he learns to get his facts straight, he will continue to be wrong every time he tries to promote the fossilization of English.

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Since reading Jack Straton's letter, I have conducted an unscientific survey among the women around me. I asked militant and conservative, black and white, learned and learning, young and old. Not one had any inkling of Straton's supposed origin of the phrase "rule of thumb." If they expressed any curiosity as to why I asked, I showed them the reason for my question. The reaction was universal: They laughed. They all thought the letter as ridiculous as I did. To link physicists with the violence against women in the United States, even by inference, is unconscionable.

As a Mexican-American am I supposed to bristle if someone uses the term "bean counters" for statisticians? Should I find some slight if someone talks about "sour grapes"?

I have not been deputized to speak for any other Mexican-Americans, and I am sure that Straton does not speak for me. I resent his claim that as a group we physicists must "educate ourselves." People of goodwill will put more importance on intent than on a particular word or phrase. As a member of a minority

group, I have never expected anyone to give me any special consideration. I expect to be treated as just another individual.

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Jack Straton's letter linking the use of the idiom "rule of thumb" with modern-day violence toward women prompted me to expose another example of social insensitivity in the technical jargon.

Why do we use the phrase "master-slave" in the technical description of the edge-triggered flip-flop? After all, slavery has been a blot on civilization since at least the time of the bondage of Jews in ancient Egypt. In sympathy with the suffering imposed by slavery, I propose a more socially neutral phrase, such as "team leader and significant other," to describe the operation of edge-triggered flip-flops.

Well, while I await the reprinting of the TTL data book as one measure in righting the injustices resulting from the aftermath of slavery, such as the segregation and racial discrimination that clearly still exist in this country, I wonder if the trivial prescriptions offered by Straton and myself only delay the day when serious measures to right these injustices will be implemented.

Nevertheless, in the future, my rule of thumb will be to avoid rules of thumb. I'll do the derivation instead.

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Correction

January, page 40—Figure 4 is from C. Durfee, J. Lynch, H. M. Milchberg, *Opt. Lett.* **19**, 1937 (1994). ■

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