

letters

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understanding of vibration-rotation spectra of polyatomic molecules. What is sad is that he chose to do so by attempting to belittle the Harter-Patterson work. There is no doubt that the work of Hougen, Watson, and others has been equally deserving of PHYSICS TODAY coverage in years past. Fault for this does not lie in a July 1984 "Search and discovery" article, but rather in a collective failure of physicists in the field to generate the enthusiasm necessary for this kind of coverage. Harter and Patterson present a new, dynamic point of view, both figuratively and literally. If it attracts a public following, then so much the better for the rest of us. Instead of bickering, we should be bootstrapping ourselves into higher prominence in physics, with the attendant increase in funding and student interest. Let us hope that Bunker's letter is just an isolated example, and not the beginning of a trend.

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10/84

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Physics and the military

It is difficult to believe that anyone as smart as Charles Schwartz could be so oblivious to the obvious. In his guest comment for October (page 9), he devotes several pages to illustrating how physicists either wittingly or unwittingly contribute to the military security of the United States, the point of it all being that it is wrong, wrong, wrong. But it is Schwartz who is wrong.

The obvious facts are that the Soviet Union is a totalitarian dictatorship bent on world domination through the spread of its system to all corners of the globe; that the Soviet Union has been thwarted in its schemes by the military power of its chief adversary; that if the Soviet Union were truly interested in a verifiable control of weaponry, it would agree to on-site inspections; and that if all the physicists in the United States followed Schwartz's suggestions to weaken our military preparedness, there would be unbounded glee in the Kremlin.

Schwartz bemoans the risks of stockpiling nuclear weapons, but the fact is that until nuclear weapons were stockpiled, wars were wreaking havoc on this planet with increasing destruction and frequency. It seems very likely, on the basis of experience, that had only conventional weapons been available, a third world war, pitting the democracies against Russia and her satellites, would already have battered the earth.

No one likes living with potential annihilation. But I prefer that risk to

the certainty of conventional war or to life under the Soviet system. I especially prefer that risk in light of the fact that the nuclear deterrent has given us peace and freedom during 40 years of the most dangerous of provocations.

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Degeneracy in perturbation

The insidiousness of degenerates was recently brought home to me subsequent to preparing a lecture on time-independent perturbation theory for my quantum course. The subject was the case of degenerate levels. For some time, I had believed that the first-order corrections to the "correct" zero-order degenerate eigenkets were orthogonal to the subspace S spanned by these kets. When I tried to prove this, however, I soon discovered that such orthogonality was generally incompatible with the second-order equations which, somewhat to my surprise, together with normalization conditions, determine the projections of the first-order corrections on S . A short calculation using the second-order equations gives, in fact:

$$|E_n^{(1)}\rangle = \sum_{s>g} \frac{V_{sn}|E_s\rangle}{E_n - E_s} + \sum_{\substack{m<g \\ m \neq n}} \frac{V_{mt}V_{tn}|E_m\rangle}{(E_n - E_t)(V_{nn} - V_{mm})}.$$

Here, $|E_n^{(1)}\rangle$ is the first-order correction to the correct zero-order ket $|E_n\rangle$, assumed to be degenerate in zero-order with the kets $|E_m\rangle$, $m = 1, \dots, g$. The latter are all assumed to be the correct zero-order kets that is, they are chosen



"RECENTLY LUDWIG MIZZELDORP CAME UP WITH SOME STARTLING DISCOVERIES IN THE FIELD OF SUBATOMIC PARTICLES. I'D LIKE TO SING YOU SOME OF HIS FORMULAS."

so that the off-diagonal elements $\langle E_m | V | E_p \rangle \equiv V_{mp}$, $m \neq p$ vanish for m and p less than g . The second term on the right-hand side is, of course, the projection of $|E_n^{(1)}\rangle$ on S and was quite unexpected.

Puzzled as to the source of my mistaken belief, I then reviewed the quantum theory books close at hand and found that most of the authors who explicitly addressed this point erroneously asserted or implied orthogonality (references 1-10). I found the correct treatment in only a few books (references 11-14). When our students submit papers to us which contain identical errors, we often suspect the absence of independent thought. Should the same principle also apply to the authors of physics texts?

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9/84

Journals for the taking

I have some unbound journals that I plan to discard if no one can use them: *Journal of Applied Physics*, January 1946–December 1970, (missing February 1946); *Science Abstracts Sec. A. Physics*, January 1937–December 1968.

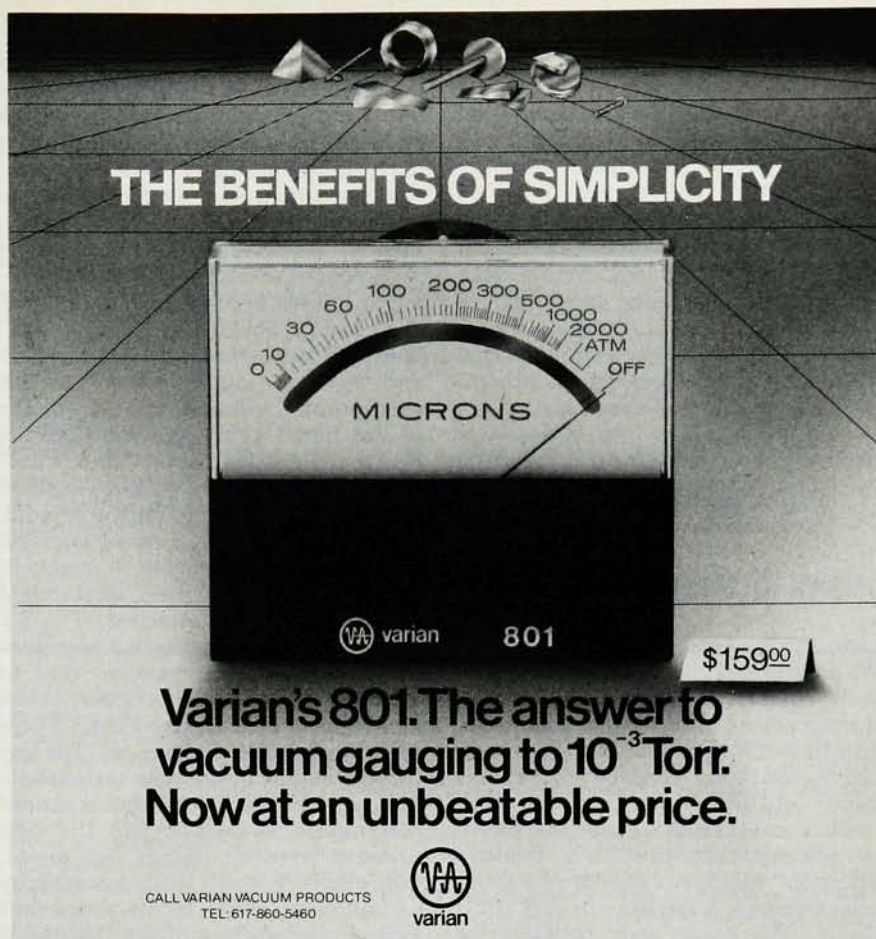
I'll let anyone have them who will pay the cost of packaging and shipping. If interested, please get in touch. My telephone number is (412) 222-4400, Ext. 253.

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Nuclear medicine

What chords resonated on reading the letter by Robert Yaes in your issue of August (page 13)! I, too, had followed the path from physics to medicine and had been astonished by the amount of rote learning necessary to obtain a medical degree. The transition from senior faculty member to student in the same institution is a unique one, not always to be recommended. However, the choice of a final medical specialty for a former physicist requires very much care if one wants to retain some value from one's physics education. Radiation therapy, though seeming to depend on principles of physics, in fact does not do so, as Yaes has discovered. The relevant principles are automated or have become province of medical physicists. The physician has little to do with these physical principles.

However, one specialty that uses physics every day is nuclear medicine, a field that is now steadily advancing its techniques, very many of which require knowledge drawn directly from physics and mathematics. In fact, in some countries such as France, a higher degree in physics is a recognized step towards specialist recognition in nuclear medicine. Further, the recent arrival of nuclear magnetic resonance imaging is an even more fertile field for the medical doctor with a strong physics background. I am convinced this technique will become at least as com-



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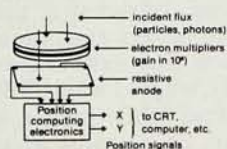
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