here for some time, which I hope will make Foner happy. Finally, while we shouldn't be discouraged by theoretical estimates, we insist that there is some value in thinking about them.

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Saturn absorption

It was a pleasure to be able to read Carl Sagan's discussion of "The past and future of American astronomy" (December 1974, page 23) after having heard his address to the American Astronomical Society during the special session devoted to its 75th anniversary. There is, however, a small point that bothers me.

In the section on spectroscopy, Sagan mentions "an absorption band at 6183 Å in the body of Saturn . . . now known to be at 6190 Å and is 6 ν_3 of methane." Recent planetary and laboratory spectra of CH_4 (H. Spinrad and L. M. Trafton, *Icarus* **2**, 19, 1963; T. Owen, *Science* **167**, 1675, 1970) show considerable structure, which makes it difficult to assign a band origin or center until a theoretical analysis is made. Furthermore, it appears unlikely that the attribution 6 ν_3 is definitive on the basis of what we presently know from high resolution infrared spectra of CH_4. It seems that an early unproved quantum mechanical assignment has "hardened" over the years into a "scientific fact." The cautionary remarks of G. Herzberg (*Infrared and Raman Spectra of Polyatomic Molecules*, Van Nostrand, New York, N.Y., pages 308–309) are particularly relevant here.

I hope that my comment amounts to more than just nit-picking. If the CH_4 band at 6190 Å were to be studied by multiple-photon laser techniques, it might be essential to know whether the spectral features of interest belong to 6 ν_3 or some other overtone or combination band.

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Laser corrections

The news story published in the April issue (page 18), entitled "Excitation-Transfer Nitrogen Lasers," contains in its last section one error and several omissions. These deficiencies leave the reader with the false impression that the N_2/SF_6 pin discharge 2nd Positive laser was developed in Los Alamos and subcontracted to The Aerospace Corporation.

The 2nd Positive N_2 bands at 3371 and 3576 A were first made to lase in resistively loaded pin discharges by Steven Suchard, David Sutton and Luis Galvan at Aerospace.[1] The indispensable ingredient to achieve threshold in these relatively slow rise time discharges is SF_6. Ultra-violet laser pulses from this device exceed in duration the N_2C state lifetime of 40 nsec. Independently, George Arnold and Robert Wenzel, of LASL, had observed energy enhancement of a factor of 10 and pulse lengths of 15 nsec with SF_6 addition to a fast rise-time device.[2] Similar effects have recently been reported by other groups operating fast-discharge lasers.[3,4]

Subsequent to the Aerospace discovery, kinetic and parametric studies based on preliminary findings were proposed to Los Alamos. Funding, however, was forthcoming through ERDA headquarters in Washington, D.C. Aerospace is not present "a subcontractor to Los Alamos on this project." This unfortunate phrase and the lack of proper acknowledgments leave the impression cited earlier.

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Trivial error/disastrous goof

Albert Claus (May, page 11) called for examples where trivial errors in calculations lead to disastrous goofs. Here is a true story my father enjoys telling on himself.

It all happened one Spring day at the Oak Ridge National Laboratory. And what better place to test a premise with scientific fact? Setting out for a nearby reactor site, Sam Hurst, then a brand-new physicist, was given directions on where to find the company car that was to provide his transportation. He was given a description of the car, its license plate number, and was told that the keys would be beneath the floor mat. Soon, our intrepid sojourner came upon the vehicle in question, and every bit of information was confirmed except that the final digit of the license plate number was off by one. "That's close enough for me," thought Hurst, "my wonderfully logical and scientific mind assures me that only one chance in ten thousand exists for this to be the wrong car." So away he drove, feeling certain that this black Ford was the one intended for his use.

Not long after his arrival at the destination, Sam was relentlessly accosted by the company guards. It seems that

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his Ford was in fact the one intended for the newly-widowed Mrs Enrico Fermi, who was on a VIP tour of the facility. Sam's now infamous "One Chance in Ten Thousand" theory had proved futile. And so it was that a confident young scientist became the hapless victim of his own unyielding faith in mathematical approximation.

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Motivating students

I have read Thomas Baldwin's letter (March, page 9) concerning high-school students shunning a career in physics. I want to share some thoughts on this subject with the physics community. I have taught physics at Virginia Tech for many years. During this time I have heard many unhappy students on the campus complaining about physics courses. I have also had an opportunity to interact socially with many people of our local community. Whenever I have mentioned to my dentist, physician, surveyor, lawyer, accountant, banker or a nice lady at an evening party that I am a physicist, they have invariably complained about their rough experiences with physics courses during their education. They have carried the impression that physics was hard, the teacher was dull and the grades were terrible, compared with other subjects.

I am confident most of these people must be good students; otherwise they would not have made it through the professional schools. Their negative impression about physics definitely propagates through the word-of-mouth publicity and discourages students from taking physics.

Is physics really hard, or is it the fault of physics teachers who give this impression to the students? I have often heard physicists remark that Nature is simple, thus any theory explaining laws of nature must be simple; so I don't believe physics is really harder than other subjects. It is the fault of physics teachers, especially at the high-school level, because they don't care enough to teach in a way that the students can understand. I have visited many schools in the rural areas of Virginia to find out that some high-school physics teachers never had much physics themselves. I do know some of the better schools where physics teachers are well qualified—but the fact remains that in many schools across the country professionally trained physics teachers are needed.

There is also a need for introducing physics in the science curriculum at earlier grade levels. In most schools there is a somewhat even distribution among men and women teachers in biology, chemistry and mathematics—but there are very few women teachers in physics. If more women were teaching physics, they might create a classroom atmosphere in which boys and girls will feel at ease and can learn better.

Recently my wife and I had an opportunity to "team-teach" a self-paced course in non-calculus physics. We worked with each student individually to find out his ability, learning style and rate of learning, and then designed our instruction to suit his needs. We videotaped our lectures and made them available to the students in the learning resource center so that they can use these films at their own convenience. Students participated in student–student and student–teacher interaction sessions for solving physics problems. We used psychological motivational techniques to generate enthusiasm among students for physics. The student achievement in this course was measured against standardized tests. Out of 69 students who took this course, 58 students did better than 85% on the final examination on which the average was predicted to be around 65. We taped student interviews in the last week of the quarter and their comments were very complimentary; they all wished for this kind of personal attention in their other courses. I conclude this letter by saying that there is hope for attracting more students in physics, but we certainly need to change our attitude and work harder in motivating toward physics.

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Restricting enrollment

The report by Martin Perl and Robert Good on the Conference on Tradition and Change in Physics Graduate Education (June, page 9), recommends that "There should be *no* increase in physics graduate enrollment in the forseeable future." They go on to observe that it is in the best interests of individual departments to recruit graduate students, which is the well-known "tragedy of the commons." Clearly there will not be a voluntary cutback in enrollments by all departments, and those that do will suffer in comparison with their less altruistic competitors. It is regrettable but true that the tragedy of the commons can only be resolved by collective action involving some measure of coercion.

For several years I have campaigned for such action, recommending that a program of accreditation based on the faculty/student ratio be used to identify those departments with overly large graduate enrollments. At this conference, as in the past, the physics community has exhibited a great reluctance to