letters

Shortest wavelength

In the November issue, a news story entitled "Coherent sources of extreme uv" (page 19) represented the 93-nm stimulated emission from inner-shell electrons in krypton as "the shortest wavelength reported for stimulated emission." However, some previously reported stimulated emissions include 11.741 nm in Al,[1] 0.15 nm in Cu,[2] 5.823 nm in Cl,[3] 18.2 nm in C,[4] 13 nm in Mg,[5] and 1.4 nm in an unspecified material.[6] While some of these reports have been disputed, others still have believers.

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We made it quite clear that we were quoting from an article about to be published by Rhodes and his Chicago colleagues. The quote we excerpted begins with the caveat "To our knowledge this . . . represents the first. . . ." —BMS

Inadvertent slight

David S. Heeschen's otherwise excellent obituary of Bart J. Bok (December, page 73) refers to the excellent ANU Siding Spring Observatory as "... *the* (emphasis added) major observatory south of the equator." If it had read "... one of the ..." instead, it would have avoided making a value judgment that inadvertently slights, among others, the US's own national observatory in the southern hemisphere, the Cerro Tololo Inter-American Observatory; The Carnegie Institution's Las Companas Observatory; the European Southern Observatory (all three of which are located near La Serena, Chile); and the Anglo-Australian Observatory (located on Siding Spring Mountain but autonomous of the ANU). As justifiably proud as Bart was of his accomplishments in the development of Siding Spring Mountain as an astronomical observing site, I'm sure he would have been the first to protest the unfortunate choice of words; after all, virtually all of his observing since 1966 was with the superb facilities at Cerro Tololo.

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THE AUTHOR COMMENTS: James Hesser is quite right. I intended to say "... *a* major observatory ..." rather than "... *the* major observatory ..." I did not intend to make a value judgment.

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Development of radar

With reference to the letters of W. D. Hershberger and Luis Alvarez in October (page 119) the idea of the radar was first formulated by my teacher, Franz Ollendorff (who was a fellow and vice-president of the IEEE—the first non-American!). After World War I, in the course of work on electromagnetic fields, he realized that reflection of electromagnetic fields could be used to locate reflecting bodies. He also introduced relativity into engineering sciences in Germany and invented the electronic microscope. I am pleased to call attention to the genius of Ollendorff and urge recognition of his rightful place in the history of science.

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Reactions to complaints abroad

The "Complaints from Abroad" concerning life in Switzerland (January, page 109) brought back memories of my year in Switzerland at the University of Zurich (across the street from the ETH). One must remember that aversion to foreigners is a Swiss trait, and recently two national referendums were held to consider (force) the expulsion of *all foreign workers*. Both failed, but not by much.

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I was disturbed to read of the unfortunate experiences of Daniel Spicer and C. H. Barrow at the Institute of Astronomy of ETH in Zurich, Switzerland. While not making any judgments regarding their complaints, I tend to believe their case was the exception rather than the rule at ETH.

I was a postdoctoral fellow at ETH in the 1960s (Laboratorium für Festkörperphysik), and my experience was just the opposite of that of Spicer and Barrow. My family and I arrived in

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letters

Zurich in a dilapidated VW in the middle of the night, lost and broke, and Werner Kanzig met us and took us under his wing. And so it was to be for my stay in Zurich. I found the Swiss to be very helpful in all matters, we made many friends, and never once was I ever treated with disrespect or condescension. In fact, my stipend from ETH quickly proved inadequate, due entirely to my misjudgment of living costs in Zurich, and Walter Granicher and Kanzig quickly (and mysteriously) found an additional stipend for me. In short, I have only fond memories of my stay in Zurich, and we were very sad to leave Switzerland. I have visited ETH every two or three years since my postdoc there, and I have never detected the ostracism Spicer and Barrow complain of.

I found Switzerland to be a country of impeccable standards of honesty, integrity and hospitality—would that I could reverse the unfortunate experiences of Spicer and Barrow.

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Mathematics as an obstacle

In connection with the discussion on educating the younger generation in the physical sciences (September, page 25), I would like to mention a general difficulty.

The laws of physics are formulated as differential equations: for example, Newton's laws of motion for a particle, a rigid body and a gyroscope. Maxwell's laws of electromagnetic field are partial differential equations, and so are the laws of gas dynamics.

The teenagers are able to understand all this stuff.

A more exact statement is that they are *unable* to understand deeply and to love physics if the needed mathematical vocabulary is lacking. Here is my point: In most cases, the calculus begins late and involves difficult and tedious elements of set theory and the theory of limits.

The so-called "rigorous" proofs and existence theorems are much more difficult than the intuitive approach to derivatives and integrals.

The result is that the mathematical ideas needed to understand physics come to teenagers too late. It's like serving the salt and pepper needed for lunch somewhat later—during five-o'clock tea.

I tried to remedy the situation by writing in 1960 *Higher Mathematics for Beginners*; more than half a million copies were printed. The last edition with I. Yaglom was printed in 1982 and translated into many languages. But I do not know of any attempt to use it as an official school (college) textbook.

An anonymous group of talented mathematicans invented Bourbaki, called him an army general and wrote under this pseudonym a comprehensive course of modern mathematics, beginning in the first 7 or 10 volumes with set theory and abstract algebra, and ending with calculus.

Perhaps the high military rank ascribed to Bourbaki made his position strong in education. In many countries the difficult ideas of set theory and formal limit theory are exposed to twelve-year old boys and girls. Obviously this is a very difficult barrier to understanding things that are much simpler—the intuitive understanding of the derivative as velocity or of the integral as area. The use of minicalculators could be very useful in understanding calculus. But most important is the interaction of math and basic physics.

A mixed course of physics and calculus (including vector fields) would be a blessing for both physics and mathematics.

The division of mathematics and physics and the Bourbaki approach in teaching math to beginners are disastrous.

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Polymeric fluids

In their excellent article "Fascinating Polymeric Liquids" in January (page 36), Byron Bird and Charles Curtiss mention several phenomena in which polymer melts and solutions behave in unexpected ways. In particular, the behaviors shown in figures **1a**, **1b**, **1c**, and **1e** (rod-climbing, die-swell, and so on) are ascribed to the fact that these fluids have a non-zero first normal stress coefficient. They state that the first normal stress coefficient is positive in polymeric fluids. While this is undoubtedly true in the vast majority of cases, I would like to point out that several cases are known in which this quantity is negative. Roger Porter and I have observed lyotropic solutions of helical polypeptides give rise to large, time-independent negative normal stresses. It was further observed that the sign of the first normal stress difference depended on shear rate, changing from positive to negative and then back to positive with increasing shear rate.[1,2] These changes in sign corresponded to observable texture changes in these liquid crystalline solutions when viewed under crossed polars.[3] A mathematical model that de-

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