held in secret.

Most of the nearly one hundred papers at NPL-92 were presented by Russian authors and discussed a variety of lasers powered by nuclear reactors. The Russian reactor-powered-laser research programs were remarkable for their breadth and sophistication. Two new lasers were reported, and the performance of existing lasers was characterized in new parameter ranges. Numerous other papers reported on fission-fragment excitation cross sections, excitation of liquid laser media, a neutronic mockup of a reactor-pumped laser system, calculations and measurements of laser beam quality, uranium coating integrity and specialized nuclear reactor facilities. Key Russian scientists stated that their research programs had achieved great success before the first US reports of reactor-pumped lasers, in 1975.

NPL-92 provides evidence of a new orientation toward peaceful applications of weapons science. Russian scientists suggested various uses for nuclear lasers and even proposed Earth-orbiting reactor-powered lasers that would produce powerful beams to vaporize space junk that is becoming a serious navigational menace to satellites.

Two Russian papers presented at the conference described two underground experiments on nuclear-explosive-driven optical lasers conducted in the early 1980s. Technical details of the laser configuration such as the hardware geometry, nuclear pumping mechanisms, lasant composition and beam energy output were discussed. The purpose of these experiments, according to the Russians, was to develop an alternative source of beam energy for research on inertial confinement fusion.

One day of the conference was devoted to touring several laboratories in the vicinity of Moscow that until recently had been closed to foreigners. At IPPE, Russian scientists demonstrated research facilities for developing reactor-powered lasers: a new pulsed reactor facility (BARS-6), the aforementioned neutronic mockup of an RPL system (VKS-1M) and facilities for studying degradation of laser gas and for measuring laser level properties. Visitors to the Troitsk Institute for Innovation and Thermonuclear Studies toured several important experimental facilities for ICF research: the TIR-1 CO_2 laser, the MISHEN-II Nd–glass laser and the ANGARA-V pulsed-power particle-beam accelerator. Visitors to the Obninsk technology center for the production of nonmetallic materials viewed parts such as ceramic tiles and windows produced for the Buran space shuttle, ceramic turbine blades, crushable hexcell and a variety of specialty consumer products.

One US participant was shown through the Institute of Experimental Meteorology at Obninsk by an acquaintance who is now the director. The tour revealed a wide array of unique capabilities, including a 3000-m^3 state-of-the-art cloud chamber for optical studies of droplet and crystalline fogs. Significant achievements at the institute include successful cloud-clearing experiments using CO_2 lasers.

The American contribution to the body of information presented at NPL-92 was small; most of the presentations were given by Americans from nongovernment organizations. Although scientists affiliated with the US Departments of Energy and Defense attended the conference, only two papers were presented from those organizations. This clearly disappointed the Russians, who complained that they had opened their laboratories to Western scientists and had released closely held information on both reactor-driven and nuclear-explosive-pumped lasers but had received relatively little information in return.

The next NPL conference is tentatively scheduled for 1994—as an open meeting at Arzamas-16, the Russian Scientific Research Institute for Experimental Physics.

David McArthur
Sandia National Laboratories
Albuquerque, New Mexico
Stephen Matthews
Lawrence Livermore National Laboratory
Livermore, California
Gerard Quigley
Los Alamos National Laboratory
8/92 *Los Alamos, New Mexico*

Hold Recommendation Letters for Later

I am writing about a concern I have with the job listings in PHYSICS TODAY. For almost all of the faculty positions advertised three letters of recommendation are requested. For the job applicant, who may literally apply for over a hundred positions, this means asking references to send out a lot of letters. Given the current employment climate even small schools can receive hundreds of applications. Since most candidates will be eliminated simply on the basis of their resumes and research interests, is there really a need for a letter of recommendation in the early stages?

Although word processors and secretaries can lighten the burden for some, this requirement still represents quite a bit of work. Additionally, the applicant is placed in the awkward position of repeatedly asking for a letter of recommendation, and in most cases this will be for a job for which the applicant will not be seriously considered.

I ask that prospective employers hold off asking for recommendation letters until they have narrowed the field to serious candidates. (They can still require names and addresses of references.) This would cut down on the paperwork employers have to wade through, and it would make things easier for those searching for positions.

Bruce W. Liby
US Air Force Phillips Laboratory
Kirtland Air Force Base,
1/93 *New Mexico*

O_3 Hole: No More than the Sum of Its Past?

I believe Barbara Goss Levi's news story on Arctic ozone depletion (July 1992, page 17) should have appeared in another department, perhaps Opinion. Historically, knowledge of the Arctic gap, hole, crack or cavity dates back about three-quarters of a century.[1] And the Antarctic ozone hole, which has been featured in the popular press as a recent discovery, was detected over Halley Bay during the International Geophysical Year (1957–58).[2]

If there was already an annual drop in the ozone over both polar regions before humans introduced chlorofluorocarbons into the atmosphere, what caused the annual variation (or hole or gap or cavity or crack)? Isn't it more likely that the recent introduction of CFCs only amplified a naturally occurring event and does not deserve to have been treated as a "cause célèbre" by writer after writer?

References

1. F. W. P. Gotz, in *Compendium of Meteorology*, T. F. Malone, ed., Am. Meteorological Soc., Boston (1951), p. 275.
2. "Dobson on the Ozone," Eos, 28 February 1989.

Norman S. Benes
8/92 *Placerville, Calfornia*

Levi replies: True enough, ground-based and satellite data taken since the early 1960s have established that the ozone levels in Antarctica have a minimum between September and November. According to Mark Schoeberl, head of the atmospheric chemistry and dynamics branch at the Goddard Space Flight Center, this minimum is a natural phenomenon arising from the normal circulation in the lower stratosphere. But when atmospheric scientists talk about the "ozone hole" today, they refer to the depletion *after* this normal variation has been taken into account. Schoeberl stresses that "the ozone hole is a real and recent physical phenomenon; the data are unambiguous."

Norman S. Benes's reference 1 shows data taken with a Dobson spectrophotometer before 1948 at Arosa, Switzerland, and at Tromsø, Norway, which is above the Arctic circle. The Tromsø data suggest an especially strong seasonal variation of ozone level, which the author of the report terms an "ozone gap." However, Schoeberl tells us that the Dobson data taken during winter by twilight or moonlight—precisely the points that show the greatest deviation—are usually quite unreliable. Satellites measuring the total amount of ozone in a vertical column of the atmosphere have not detected an ozone hole over the Northern Hemisphere to date.

Benes's reference 2 reprints material written in 1968 by G. M. B. Dobson, who remarks on the differences in the ozone amounts in the Northern and Southern Hemispheres at equivalent times of year. According to Schoeberl, these are normal climatological differences caused by the different stratospheric circulation systems in the two hemispheres.

Champagne vs Beer: Comparative Fizzics

Gianni Astarita (July 1992, page 91) does well to bring a familiar fact to the attention of his engineering students to illustrate transport phenomena. But his example, the difference in the foam stabilities of champagne and beer, though striking, is not pertinent, and his explanation, though ingenious, is not correct.

First, the Marangoni stabilizing mechanism, while applicable to ephemeral foams such as those of champagne, is not by itself sufficient to stabilize longer-lived foams such as those of beer, whipped cream or shaving cream. The Marangoni effect is the movement of a liquid surface under the influence of a surface-tension gradient: The movement is from the lower- to the higher-surface-tension regions. In foam films the surface-tension gradient arises from the drainage of the liquid, which is pulled both by gravity and by Laplacian pressure differences created by the curvature of the surface at the Plateau borders. As the liquid film drains, the surface drains with it, thereby reducing the concentration of adsorbed solute in the thinnest portion of the film, causing its surface tension to rise. The Marangoni effect then operates to pull the surface back (and, by viscous drag, a considerable thickness of underlying liquid as well) to restore the thickness of the rapidly diminishing foam film. But this mechanism operates for a short time only, a matter of rather less than a minute, before the foam has drained to a state of dryness that cannot provide enough of the underlying liquid to sustain the stabilizing action.

The stability of beer foam results from another mechanism, namely, the retarding of drainage by the plasticity of the foam film. That plasticity, in turn, is caused by molecules of a solute, such as a protein, that are adsorbed at the surface and bonded there into thick coherent layers by Lewis acid–Lewis base interactions. The Marangoni effect may initiate the stability of bubbles, but the stability is enhanced to a prolonged life by the plasticity conferred on the liquid surfaces. To act in this way, the solute has to be something much more surface active than carbon dioxide, which has only a minor effect on the surface tension of water at the pressures we are considering. Even in champagne, the carbon dioxide is not likely to be the solute responsible for the reduced surface tension and for the stability of the bubbles, transient though they are.

Sydney Ross
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9/92 *Troy, New York*

Astarita replies: I would like to thank Sydney Ross for providing me with an opportunity to make myself very popular with some graduate students. In the interest of science, I bought all of them a round of beer and asked them to estimate experimentally the order of magnitude of the drainage time of the foam. The estimates ranged between 20 seconds and 2 minutes: not very far from the upper limit that Ross assigns for the significance of the Marangoni effect. So perhaps protein adsorption at the interface and the consequent plasticity of the foam film are important in