

## APPLICATION OF LASERS

**A**N informal conference on scientific and industrial applications of lasers was held at the National Physical Laboratory, Teddington, during April 23–24. Three hundred people (the maximum number it was possible to accommodate) attended, of whom twenty were from overseas.

The first day was concerned with gas lasers. During the morning, papers were presented on a variety of applications, including metrology, geodesy, communications, optical testing and alignment, navigation and machine tool control, and these and other topics were discussed during the afternoon session. The laser, as one speaker put it, is a solution in search of a problem. At present it is mainly useful in science, and there are few applications earning money, but many where it is a very convenient light source. It was generally agreed that for broad-band communications a further decade of component development is needed, and even then millimetre wave-guide communications systems may be preferable. For many other applications such as optical testing the greater convenience of the gas laser as a light source must be balanced against its greater cost. In machine tool control the laser is capable of quite unnecessarily high accuracy, but requires rigorous and expensive control of machine operating conditions. The stability of existing continuous wave gas lasers could profitably be improved, but otherwise they seem to be satisfactory. The pulsed gas laser holds promise for micro-machining of thin films.

After tea, some of the laser work in the Light and Standards Divisions of the National Physical Laboratory was displayed, and a number of commercial gas and solid-state lasers, mostly British, were demonstrated by the makers.

The second day was spent discussing pulsed solid-state lasers, the principal characteristic of which is their ability to compress energy in time, space and frequency. A paper on the applications of neodymium-doped glass lasers to machining, welding, the spectral microprobe and computers was followed by papers dealing with diode lasers, micromachining, atmospheric studies, satellite tracking, beam-riding guidance systems, electron emission from laser-heated surfaces, generation of submillimetre waves, range-finding and ophthalmic surgery. For metal cutting operations the laser, though energetically ineffi-

ent, is in competition with the electron beam machine, which can work only in a vacuum. One speaker found that ease of cutting depended on the thermal conductivity of the material, while another found that the reflectivity and binding energy were the important parameters. The laser may find application in dentistry for the selective vaporization of caries in teeth, and in surgery for drilling thin bone. It is already in successful use for anchoring detached retinae. Tungsten surfaces receiving a focused laser beam produce high-density electron emission, and may be useful as the cathodes of millimetre wave valves. Range-finders using gallium arsenide diode lasers and ruby lasers were described, with ranges of the order of a mile and accuracy of 1 in  $10^4$ ; the diode laser has the advantages of ease of modulation, compactness and high pulse repetition rate.

During the second afternoon discussion session many people wanted to know more about neodymium glass lasers. This material has the great advantage over crystalline materials that it can be produced in large optically homogeneous blocks with quite high neodymium concentrations. In pulsed operation with water cooling, a pulse repetition frequency of one a second has been achieved, but the cost goes up more than proportionally to the repetition rate. The surface damage observed at high pumping power densities can be avoided by cladding the neodymium glass with a plain glass, and solarization is prevented by filtering out ultra-violet radiation. The difficulty of obtaining laser pulses longer than 1/100 sec, desirable for welding applications, was emphasized. On the question of range-finder accuracy, improved narrow-band filters for the detector would be helpful, though thermal drift of the transmitter wave-length would have to be considered.

Many applications had to be left out, or received only cursory attention, including high-speed photography, plasma physics, vision in fog, testing of optical components and education in optics.

Commercially, perhaps, the picture presented was disappointing, at least in the short run. Much development remains to be done before many industrial applications become possible. It is still true that the principal applications of the laser are in scientific work, where it is invaluable.

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## ORDER-DISORDER STRUCTURES

**A** SYMPOSIUM on order-disorder structures was held under the auspices of the Slovak Academy of Science and the German Academy of Sciences in Berlin at Castle Smolenice, near Bratislava, during May 19–23. There were some sixty participants from six countries, namely, Czechoslovakia, German Democratic Republic, Hungary, Japan, the United Kingdom, and the U.S.S.R. The symposium was organized by Prof. K. Dornberger-Schiff (Berlin) and Dr. F. Hanic (Institute of Inorganic Chemistry, Slovak Academy of Science).

Prof. Dornberger-Schiff gave a review of the subject, which in its present stage of development owes very much to her and to colleagues in Adlershof. A foundation has been given to the systematic theory of the symmetry operations which are involved in the separate layers, and in their mutual arrangements, in a large class of order-disorder structures. The application of these conceptions to the solution of the structure of strontium germanate was very striking. Prof. B. B. Zvjagin (U.S.S.R.) proposed a classification of layer silicates and Dr. V. A.

Dritz (U.S.S.R.) discussed the imperfections in lizardite. The silicates were also the subject of a report by Dr. J. A. Gard (United Kingdom), in which he described the application of electron diffraction to these investigations. Dr. W. A. Wooster (United Kingdom) described the application of automatic photographic and diffractometric methods to the study of diffuse reflexions of all kinds.

A group of papers dealing with problems of disorder of a more general kind was presented by several speakers. Prof. G. S. Zhdanov (U.S.S.R.) spoke about crystals showing a combination of Seignette-lectric properties with ferro- or anti-ferro-magnetic properties. Dr. L. Zsoldos (Hungary) dealt with a new approach to the problem of the disorder shown by  $\text{Cu}_3\text{Au}$ . Dr. K. Doi (Japan) gave an analysis which permits of a direct determination of atomic displacements in disordered alloys. Prof. A. J. C. Wilson (United Kingdom) described the use of variance as a measure of line broadening and its use in the study of stacking faults.