development of an optical eddy-counting technique, including a focusing device; the measurement, by means of the hot-wire technique, of turbulence, velocity and temperature distribution along the jet; the examination of noise from jets of non-circular shape; and the study of noise emitted from special jet extensions, with annular corrugated orifices, designed to reduce low-frequency noise. Important fundamental research on the origin and nature of jet noise is also proceeding at the Universities of Manchester and Edinburgh.

The problem of aircraft noise was also debated in the House of Lords on July 7, when, for the most part, the question of legislation and responsibility for minimizing noise was discussed. Lord Hawke said that perhaps the most hopeful line of approach is in experiments with devices which act upon the gas when it leaves the jet and provide something in the nature of a gigantic exhaust box.

PHYSICAL SOCIETY

ANNUAL REPORT FOR 1953

AT the annual general meeting of the Physical Society, held at the Royal Institution, London, on May 25, the reports of the council and of the honorary treasurer and the accounts and balance sheet for 1953 were presented and adopted. During the year the membership rose by 29 to 2,130, and the sale of publications continued to increase both at home and abroad. The new scheme of subscriptions which came into operation on January 1, 1953, by which subscriptions for publications are separated from the subscriptions for membership, has worked smoothly and appears to be serving better the needs of members. There has also been a steadily growing interest in the reprint service which was introduced at the same time. The treasurer's report shows that any loss of income resulting from the lowering of the Fellows' subscription from three to two guineas has been more than compensated for by the increased income from the sale of publications of the Society. The cost of the provision of *Science Abstracts*, now no longer provided to members, was reduced from approximately £2,500 to £500. The income accruing to the Society as a result of the publication of the "Handbook of Scientific Instruments and Apparatus", the catalogue of the Society's 1953 exhibition of scientific instruments and apparatus, was considerable, amounting to nearly £4,000, and the balance of income over expenditure for the year was £1,794.

In addition to five science meetings held in London during the year, two-day meetings were held at the University of Leeds during March 31–April 1, and at King's College (University of Durham), Newcastle upon Tyne, during July 13–14; a conference on ionization phenomena in discharges, sponsored jointly by the Electrical Research Association, the Institute of Physics and the Physical Society, was held at the Clarendon Laboratory, Oxford, during July 18–23. The thirty-seventh Guthrie Lecture was delivered by Prof. Max Born, who spoke on the conceptual situation in physics and its prospects of development. The eighth Holweck Medal of the Société Française de Physique and the Holweck Prize of the Physical Society were presented to Mr. J. A. Ratcliffe in Paris in May, when Mr. Ratcliffe delivered the Holweck Discourse on the subject of diffraction of radio waves by the ionosphere. Prof. J. Bartels, of the University of Göttingen, received the seventh Charles Chree Medal and Prize on October 23, and for his address described Chree's influence on present-day geophysics. The thirtieth Duddell Medal was presented to Prof. W. Sucksmith, who gave a talk on "Some Magnetic Measurements—Techniques and Applications", and the ninth Charles Vernon Boys Prize to Prof. F. C. Williams, who spoke on "Cathode-Ray Tube Storage for Digital Computers".

Brief details of the activities of the four Groups of the Society, the Colour, Optical, Low Temperature and Acoustics Groups, together with a list of the numerous bodies on which the Society is represented, are given in the annual report. The activities of the Groups were not so varied as in former years, though the usual science meetings and summer meetings were held. The expenditure of the Groups fell markedly during the year, and, although the expense of the Groups to the Society was thus less than usual, it is emphasized that this is not a healthy sign since the activities of the Groups are vital to the welfare of the Society and any financial commitment entailed in their activities is more than offset by the contribution made by the Groups to the well-being of the Society.

At the annual general meeting the officers and council of the Society for 1954–55 were elected as follows: *President*, Prof. H. S. W. Massey; *Vice-Presidents in addition to ex-Presidents*, Mr. J. H. Awbery, Dr. R. C. Evans, Dr. A. B. Wood and Prof. S. Devons; *Honorary Secretaries*, Dr. C. G. Wynne, Dr. H. H. Hopkins; *Honorary Foreign Secretary*, Prof. E. N. da C. Andrade; *Honorary Treasurer*, Mr. A. J. Philpot; *Honorary Librarian*, Dr. R. W. B. Pearse; *New Ordinary Members of Council*, Dr. T. E. Allibone, Dr. A. H. Cooke, Prof. F. C. Frank and Prof. G. O. Jones.

ARTIFICIAL AND NATURAL COLORATION OF DIAMONDS

MOST diamonds in their natural state are coloured; but the origin of the colour is still largely a mystery. There is little evidence that it is due to impurities, nor is it clear as to whether the colour is generally confined to the surface or distributed throughout the diamond, though in some cases, usually diamonds coloured yellow or yellow-green, the colour has been reduced or removed by polishing and grinding the surface. The colour has then been attributed to natural radioactivity. In 1923, S. C. Lind and D. C. Barwell established that diamonds were coloured green by bombardment with alpha-particles from radium, and there have been several reports during the past decade of the colouring of diamonds by proton and deuteron bombardment, though beta-, gamma- and X-rays seem to have little or no effect. The evidence suggests that diamonds are more readily coloured by energetic heavy particles. This supports the theory that the colour centres are connected with the vacant lattice sites and interstitial atoms formed when the bombarding particles collide with the carbon atoms of the diamond lattice.

A recent study by R. A. Dugdale of the effect of neutron bombardment of diamonds in the Harwell pile BEPO and of high-energy electron bombardment and of subsequent heat treatment confirms this view

(*Brit. J. App. Phys.*, 4, 334 ; 1953). The pile radiation induced a green colour which deepened as the irradiation proceeded until the diamond actually became opaque, usually after about one week of irradiation. The changes in the absorption and fluorescence spectra which occurred on subsequent heating of the irradiated diamonds to various temperatures up to 1,000° C. were studied visually, using a simple glass-prism spectrometer, and twenty-one specimens were examined in some detail. The effect of heating five natural green diamonds was also studied. Their general behaviour was similar to the irradiated specimens. Some twenty small blue-fluorescing colourless diamonds were coloured by bombarding them with electrons of $\frac{1}{2}$, 1 and 3 MeV. energies, and the 3-MeV. bombarded specimens on subsequent heating behaved in much the same way as those coloured in the pile.

In the discussion of his observations, Dugdale refers to Seitz's statement that about 25 eV. recoil energy is needed for a carbon atom in diamond to be displaced, by bombardment, from its normal lattice site to an interstitial site, and estimates that 0·001 per cent of the atoms in diamond become Frenkel defects in a ten-hour irradiation in the pile. The plausible explanation advanced is that the green colour is associated with the lattice defects, and subsequent heating produces some mobility of the defects with some recombination and thus some reduction in the intensity of the colour.

ALLOY JUNCTION TYPE OF TRANSISTOR

A SPECIAL article entitled "New Advances in the Junction Transistor", by E. W. Herold, of the R.C.A. Laboratories Division, Princeton, N.J., which is printed in the April issue of the *British Journal of Applied Physics* (5, 115 ; 1954) will be of particular interest to solid-state physicists and to electronic engineers. The article is based on a lecture delivered by Mr. Herold in London on October 20, 1953, and in it a survey is given of recent research conducted in the United States into the alloy junction type of transistor which is now likely to supplant the older point-contact form. Taking as an example *n*-type, single-crystal germanium with indium as impurity, Mr. Herold describes first the various steps in the formation of a transistor junction where a technique involving alloying is utilized. A piece of indium is placed on the germanium, and the temperature is raised until the indium melts. On heating further the molten indium becomes saturated with germanium, and then, when the temperature is lowered, the germanium crystallizes out into indium-contaminated *p*-type form. The position and shape of the junction formed are, in principle, closely controllable by variation of the contact area between the *p*-type germanium and the *n*-type base, the volume of indium and the maximum firing temperature ; but, in practice, surface wetting is a possible variant which must also be controlled.

The *p–n–p* alloy junction transistor made by using two junctions on opposite sides of a thin germanium wafer is considered next, and its performance is discussed in terms of the current amplification factor α. The effects of the geometry, surface combination and emitter current injection on α are separately analysed, and the high-frequency limitations and the equivalent circuit of the junction transistor are described in some detail. It is shown that the chief factors limiting frequency response can be reduced in magnitude in an improved *p–n–p* radio-frequency amplifier transistor, the details and dimensions of which are given, and which are compared with the earlier type *TA*153. Measured values show that the base-lead resistance is reduced by 5, the barrier capacitance by 3·5 and the diffusion capacitance by about 20 times, but the resistance between collector and base is less than that of the type *TA*153 transistor. Hence, α remains about the same with partial sacrifice of low-frequency gain but with great improvement in high-frequency performance. The improved form of transistor has an upper oscillation limit between 40 and 75 Mc./s.

Finally, an experimental all-transistor personal broadcast set using six of the new radio-frequency transistors and three other transistors is described. It is smaller in size than the battery-operated all-valve receiver sold in the United States under the designation 'personal portable', has about twice the audio-frequency output power and runs off a battery consisting of six ordinary flashlight cells lasting 500 hours.

MEASUREMENT OF ELECTRODE POTENTIALS IN LIVING AND DEAD TISSUES

By DR. D. B. CATER and DR. A. F. PHILLIPS
Departments of Pathology and Radiotherapeutics, University of Cambridge

IN the course of an investigation of the effect of oxygen on tumour tissue, a method has been developed for measuring platinum electrode potentials in tumours and normal tissues. Using rats bearing either Walker carcinoma 256 or Jensen sarcoma, definite potentials are obtained which respond in characteristic ways to various experimental procedures, such as the administration of oxygen, or the injection of 2-methyl 1 : 4-naphthohydroquinone diphosphate ('Synkavit')[1]. Different methods of killing the animal result in markedly different and characteristic changes in the electrode potentials.

The electrodes consist of fine platinum wires, insulated by a coating of 'Araldite 985E', supplied by Aero Research, Ltd., Duxford, Cambs. A bevel is ground at the end, and this is scraped clean with a glass knife to produce a bright platinum surface of small dimensions. Cemented alongside the wire, leaving 1 cm. projecting, is a short plastic guide tube, through which can be passed a modified hypodermic needle having a bevel 1 cm. long. The hypodermic needle is used to guide the wire into the tissues, after which the needle is withdrawn, leaving the electrode *in situ*. The electrodes can be sterilized by boiling, and are suitable for insertion into animal or human tissues with a minimum of trauma. Small silver – silver chloride electrodes are used to complete the circuit ; it does not make any difference into what tissues these are inserted. Simultaneous measurement with a glass electrode records any changes of *p*H. Glass electrodes of capillary form have been used, both made by us using the method of Voegtlin *et al.*[2] as modified by Kahler and Robertson[3], and as supplied by the Cambridge Instrument Co., Ltd. The impedance of these ranges from 2 to 10 × 10^8 ohms.