THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON

RECENT publications by the National Physical Laboratory, Teddington, have included the annual report for 1963, and three new publications in the series *Notes on Applied Science* and a reprint of No. 12, *Calibration of Temperature Measuring Instruments*[1]; as well as second editions of the booklets entitled *The Inclusion of Equivalent Metric Values in Scientific Papers*[2] and *Units and Standards of Measurement in Light (Photometry, Colorimetry and Radiometry)*[3].

The illustrated annual report includes, as usual, the report of the Executive Committee for 1963 which was presented to the General Board at its meeting on May 26, 1964, and detailed reports by the superintendents of the activities of the nine divisions of the Laboratory and of administrative matters by the secretary of the Laboratory. Altogether 53 different fields of investigation are described in the 255 pages of the report. Several of these were on show during the open days on May 27–28, 1964 (see *Nature*, 203, 579; 1964).

The executive committee reported that they reviewed the work of the Aerodynamics, Applied Physics, Autonomics, Basic Physics, Metallurgy and Standards Divisions, and that they considered the papers on the "Five-Year Forward-Look Proposals 1964–69" prepared for the Research Council and on the "Future Development of the Laboratory" prepared by the Director. The opinion was expressed that the Laboratory should be allowed to expand faster than in the past and that there was no longer difficulty in recruiting enough staff of high quality. The large and successful magnetic resonance section of the Applied Physics Division, where the main investigation is that of electron spin resonance of free radicals trapped in irradiated single molecular crystals, and the polymer physics section where basic work of considerable importance to industry has been performed, are singled out for special mention. The Metallurgy Division, which has a high reputation internationally, has the continuing problem of maintaining the correct balance between fundamental studies and applied research. The Standards Division was in urgent need of additional accommodation and highly qualified scientific staff to further its large and expanding programme of maintenance and development of the standards of measurement. The construction of a hydrogen maser for use as a frequency standard and a new determination of the constant of gravity (G) are two major projects mentioned in the Committee's report.

The Committee attached great importance to the need for the scientific staff of the Laboratory to keep in touch with industry so that the research programme should be directed towards industrial needs, and to ensure that the results of research are applied in industry as quickly as possible.

At the end of 1963 the number of Scientific Officers, Research Fellows and Experimental Officers on the staff of the Laboratory was about 550. It is interesting to note that some 120 overseas visits were made by staff during the year. During the summer there were eight vacation consultants, and 43 vacation students (three holding grants from the Department of Scientific and Industrial Research) working at the Laboratory. A three-day international conference on the relations between the structure and mechanical properties of metals was held during January 7–10, 1963, and a much larger conference, with an attendance of 300, was held during June 26–28, 1963, on wind effects on buildings and structures. The tenth International Towing Tank Conference met at the Laboratory during September 4–11, and the Hospital Physicists' Association held a one-day conference on the dosimetry of megavoltage radiation in the Glazebrook Hall on November 8.

No. 30 in the series *Notes on Applied Science* by G. Bradfield deals with the use in industry of elasticity measurements in metals with the help of mechanical vibrations. The note consists of two parts. In Part 1, a broad survey of the subject is given, in which values of the elastic constants and wave velocities for polycrystalline metals and associated materials at 20° C are listed, and the four methods of testing (resonance methods; pulse methods using high frequencies; the use of surface waves in the ultrasonic goniometer; and the frequency modulation or frequency scanning method) are described in detail together with diagrams of the appropriate equipment and apparatus. Test methods for small specimens, and for the measurement of elasticity at high pressures and high and low temperatures, the compressibility of molten metals, and the elasticity of metals during processing, are also discussed. Part 2 deals with various technical points in elasticity measurement, such as dispersion and diffraction effects, and the influence of porosity on the elastic constants and wave velocity, and of temperature and texture on the elasticity of metals[4]. Tables computed by the Mathematics Division of the Laboratory giving the numerical corrections for dispersion to the velocity of longitudinal waves in bars of finite diameter in order to yield the correct value of $(E/\rho)^{\frac{1}{2}}$, where E is Young's modulus and ρ the density of the bar material, cover 57 pages. Values are tabulated for ratios of diameter/wave-length (d/λ) 0–0·45 in steps of 0·01 and Poisson's ratio σ from 0·15 to 0·27 in steps of 0·01 and 0·25–0·40 in steps of 0·001; and for d/λ of 0–0·60 in steps of 0·005 and σ from 0·10 to 0·50 in steps of 0·005. The note contains 21 tables and numerous graphs, together with a bibliography of 88 references. An accompanying pamphlet, which may be obtained free on application, and which will be useful to scientists whose work entails the measurement of elastic constants by resonance methods, lists tables of the ratio of $(E/\rho)^{\frac{1}{2}}$ to the true velocity for bars of σ between 0·15 and 0·40 and for d/λ between 0 and 0·45. The values given are accurate to six significant figures and are linearly interpolable in σ and in d/λ throughout most of the range quoted.

Extensive use is made of Schlieren methods in aerodynamic research for studying high-speed airflow, because the changes of refractive index accompanying the density changes across the airflow can be readily observed. Schlieren methods, however, are not limited to aeronautical applications, and the second booklet, No. 31, in the series[5], by D. W. Holder and R. J. North, includes a brief section listing some of the many non-aeronautical applications. After a discussion of the principles of the various Schlieren methods and the arrangements for the Toepler and graded-filter methods, techniques for setting up the apparatus and the quality required for the optical components are considered. Special Schlieren methods giving images in colour, and systems using non-parallel light beams or double passage of the beam through the field under examination, are discussed, together with methods for quantitative use, involving photographic densitometry, phase-contrast and interferometry. Other sections deal with light sources, photography of the Schlieren image, and Schlieren and direct-shadow methods for visualizing three-dimensional flow. The very wide application of the method is obvious from the 269 references listed and from the numerous firms the addresses of which are given in an appendix, who supply equipment useful in Schlieren systems.

Another is No. 34, *Principles of Pneumatic Gauging*[6], by J. C. Evans and I. G. Morgan, and gives an up-to-date account of the pneumatic method of measurement, whereby a dimensional change is converted into a change of air pressure. The basic principle is described and the empirical equations which can be used for the design of gauges of given magnification and range are discussed. Various practical matters such as the regulation

of the operating pressure, measurement of the variable pressure and the design of the measuring head are then considered, followed by brief descriptions of the pneumatic measuring instruments and machines developed at the Laboratory. These include a pneumatic calliper and machines for the measurement of reference ring gauges, reference plug gauges, and of thin-sheet material during production. Automatic equipment for the calibration of slip gauges is being developed. Pneumatic gauges with magnifications ranging from 1,000 to 20,000 can easily be attained, and with special equipment it is not difficult to reach a magnification of 100,000. The study of the pneumatic method was begun at the Laboratory during the Second World War, but it is only in the years since the War that the manufacture of pneumatic measuring instruments has been taken up by industry in the United Kingdom and overseas. The simplicity and precision of the method, together with its flexibility, are now well known to engineers, but the technique needs to be more generally known and utilized.

The necessity for a third edition of No. 12 in the series[1] indicates the popularity and value of this booklet, and also reflects the continuing attention paid to the extension of the temperature scale and to improvements in the testing of mercury thermometers. A brief reference is made to attempts to extend the International Practical Scale of Temperature below −182·97° C, the boiling-point of oxygen, but it was too early to refer to the other revisions which have been proposed for consideration at the thirteenth General Conference of Weights and Measures to be held, probably, during 1968. The amended edition (1960) of the International Practical Temperature Scale of 1948 is printed in the appendix to the booklet.

The first edition of the pamphlet dealing with equivalent metric values for use in scientific papers[2] was drawn up by F. A. Gould in 1948 under the guidance of Sir Charles Darwin, and was intended to assist authors and editors to render numerical data expressed in British units easily intelligible to readers using the metric system. The revised edition is by P. H. Bigg and incorporates modifications such as deg C in place of °C for temperature difference. An addendum leaflet (dated December 1963) mentions the resolutions of the General Conference of Weights and Measures with respect to the SI system and the replacement of the litre by the cubic metre. Additional conversion factors are also given. In the new edition of the pamphlet on units of photometry, colorimetry and radiometry[3], the sections on equivalent luminance and the scotopic system of photometry have been brought up to date, but the two questions on the definition of the properties under conditions of partial light-adaptation, and of the adoption of standard colour-matching functions appropriate to a 10-degree field of view, are left unresolved. Reference is, however, made to the C.I.E. (International Commission on Illumination) publications which deal with recent discussions of these questions.

S. WEINTROUB

[1] Hall, J. A., and Bauber, C. R., *Calibration of Temperature Measuring Instruments*, third ed. (Dept. Scientific and Industrial Research, National Physical Laboratory. *Notes on Applied Science*, No. 12. Pp. iv+55. London: H.M.S.O., 1964.)

[2] Bigg, P. H. (revised by), *The Inclusion of Equivalent Metric Values in Scientific Papers*, second ed. (Pp. v+18. London: H.M.S.O., 1963.)

[3] *Units and Standards of Measurement Employed at the National Physical Laboratory. II, Light: Photometry, Colorimetry and Radiometry*, second ed. (Pp. iii+10. London: H.M.S.O., 1964.)

[4] *Table of Correction Function for Velocity of Longitudinal Waves in Cylindrical Bars*. (Pp. 7. Teddington: National Physical Laboratory, 1964.)

[5] Holder, D. W., and North, R. J., *Schlieren Methods*. (Dept. Scientific and Industrial Research, National Physical Laboratory. *Notes on Applied Science*, No. 31. Pp. x+106 with 29 plates. London: H.M.S.O., 1963.)

[6] Evans, J. C., and Morgan, I. G., *Principles of Pneumatic Gauging*. (Dept. Scientific and Industrial Research, *Notes on Applied Science*, No. 34. Pp. iii+48 with 8 plates. London: H.M.S.O., 1964.)

BUILDING RESEARCH IN AUSTRALIA

ATTENTION was recently directed to the work of the Building Research Station, Garston, Watford, Herts (*Nature*, **205**, 30; 1965), and it is therefore of considerable interest to read of the activities in the same field of the other countries, in particular in the Commonwealth; in this context the annual report, 1963–1964, of the Division of Building Research of the Commonwealth Scientific and Industrial Research Organization of Australia is welcome (C.S.I.R.O., Melbourne; 1965; pp. vi+64). As with our own building research organization, the work of this Division covers a wide and ever-increasing range of research projects in building technology to meet modern demands for higher standards of buildings large and small and in solving fresh problems of raw materials and application which are constantly arising both in the trade and in the more theoretical aspects of building science. In this report the subjects are treated alphabetically following an introduction which reviews the work of the Division for the year.

In the section on architectural acoustics, activities were mainly concerned with noise in the community; reverberation and transmission chambers; absorption studies, and noise of rain on metal roofs. Work on bituminous materials included studies of durability of roofing bitumens and rupture of bituminous roofing fabrics. In the clay and clay products section, regional studies of Australian clays continued and other work embraced ceramic materials and processes, lightweight ceramic products, long-term expansion of clay products and clay technology in general. Under concrete the subjects reported on are lightweight concrete; efflorescence on concrete products; concrete roofing tiles; creep and shrinkage of concrete in structures, and concrete floors. Gypsum plaster is discussed under titles: physical chemistry of calcium sulphate, special gypsum products and fibrous plaster. The subject of joints is mainly devoted to materials and methods available for sealing them in exterior walls of buildings to prevent rain penetration to the interior, and glazing sealants are also considered. As regards mortar, investigations are still proceeding into the effect of composition and age on the strength, modulus of elasticity, shrinkage and creep properties, a subject apparently somewhat neglected elsewhere.

The paint section has been concerned with mould growth on painted surfaces, sufficiently prevalent in Australia to have a decided nuisance value and consequent maintenance expenditure; various fungicides mixed with paints have been experimented with, but it was found that these do not invariably prevent mould growth; so far paints containing zinc oxide appear to give the best performance in this respect.

Structural testing and design are discussed in terms of flat plates, loads during construction and direct design. Thermal investigations include measurements of temperatures inside buildings and studies of solar radiation as regards intensity and direction effects on buildings. Tropical building investigations in this section have been in connexion with a survey of limestone resources and laboratory work on samples from Papua and New Guinea, and with other indigenous materials for masonry construction; in this subject a new series of publications entitled *Tropical Building Research Notes* has been initiated by the Division and will be issued about six times a year. The report concludes with an account of miscellaneous investigations, including the determination of crystal structures of interest to building materials, plastics for building repairs, and studies of foundation-structure interaction.