THE H. H. WILLS PHYSICAL LABORATORY

UNIVERSITY OF BRISTOL

DURING March 26–28 the Physics Department of the University of Bristol entertained several hundred guests with the object of showing both the teaching and the research work of the Laboratory to them. The guests included the Lord Mayor and Lady Mayoress of Bristol, professors of physics from other universities, industrial and government scientists, schoolmasters, and members of the academic staff of other departments of the University.

Apart from the numerous scientific conferences held in Bristol, including the British Association which met there last year, the Laboratory has not been on display in this way since its opening in 1927. The L-shaped building came into existence through the generosity of Henry Herbert Wills, and was designed by Sir George Oatley with the advice of Prof. A. M. Tyndall. Built on the hill where the old Royal Fort once stood, its extremely solid structure and embattled top well preserve the tradition of its name. It was originally intended to be only the first instalment of a group of University buildings, and with this in mind the north-western end was left unfaced, as it remains to-day. Grave doubts were, however, expressed at the time as to the wisdom of constructing so large a building with its two large lecture theatres, several smaller lecture rooms, library, workshops and research rooms, and all with ample provision for expansion. Three years after its opening the teaching and research staff numbered only eighteen, and many of the rooms were unoccupied. To-day, the staff number no less than seventy, and space is at a premium. Many research rooms have had galleries put in them (easily done because of the very generous ceiling heights) and special huts have been built to house both working low-temperature equipment and the mass of discarded apparatus characteristic of physics laboratories, which the occupants are not very likely to use again, but cannot bear to dispose of.

Throughout its existence, the Laboratory has been notable for the wide range of interest of its schools of research, and important contributions have been made in such different fields as magnetism, the electrical conductivity of gases, including accurate measurements of the mobility of gaseous ions, the spectroscopy of metals, the emission of soft X-rays, X-ray studies of long-chain hydrocarbons, and low temperatures. The result has been the development of a correspondingly wide range of experimental techniques and resources, and the work in progress to-day shows no less diversity. Most of the current research work, except that in theoretical physics, was displayed either by demonstrations of the working of the actual apparatus or by photographs and diagrams.

In optics, the interest is centred on high-aperture systems and interferometers for testing. A reflexion microscope of N.A. 0·95 (dry) and a meniscus Schmidt meteor camera of focal ratio *f.*/0·78 and field diameter 56° were shown, both these instruments having already attracted considerable interest outside the Laboratory. The Laboratory also houses a commercial electron microscope which is available to all departments of the University, and is occasionally used also for work on problems encountered by local industries.

The early work of the Laboratory on low temperatures has already been mentioned, and the group engaged on this study is now one of the largest in the Department. Liquid oxygen and helium are purchased in bulk, and the Laboratory also has its own apparatus for producing liquid hydrogen and helium. The main subjects at present studied are paramagnetism of crystals at low temperatures, the superconductivity and thermodynamic properties of metals, the mechanical properties of solid argon, and properties of the liquid helium film.

The Department is well known for its work, both theoretical and experimental, on the solid state, and this interest was manifested in the exhibits of several different groups. Work on the growth of both metallic and non-metallic crystals was shown, and also on the structure of macromolecular substances such as polythene and nylon. Techniques for handling single crystals of silver halides have also resulted in the elucidation of many problems connected with photographic materials, and have also enabled the dislocation structure of a solid to be studied in a particularly direct manner.

The crystalline structure of thin evaporated metal films has been studied by X-ray techniques, and the effect of conditions of deposition and adsorbed gases on the electrical properties of these films has also been the subject of considerable experimental investigation. The mechanical properties of metals, particularly the mechanism of the development of fatigue cracks, and the investigation of the creep of strained single crystals, constitute the work of another group, the aim in this case being to produce results capable of theoretical interpretation rather than of immediate technical use.

Techniques for the electronic measurement of very small strains were also in evidence in work on ferroelectrics, in which hysteresis loops not only of polarization against field but also of mechanical strain against either could be displayed oscillographically. Attempts are also being made to produce an 'artificial' dielectric material of extremely high permittivity. In all these solid-state studies the Laboratory is fortunate in being well equipped with X-ray diffraction apparatus, including single-crystal and powder cameras, a stabilized X-ray unit with an output constant to better than 1 per cent, and a Geiger-counter diffractometer for X-ray fluoroscopy.

A comparatively recently developed interest in the Department is the study of mineral separation, which centres mainly on the flow properties of fine sands or slimes suspended in water. Apparatus for bulk separation has been devised, and also an analytical tool, the 'mechanized vanning shovel', which reproduces some of the movements used by Cornish miners in assessing the separable mineral content of ores.

The largest research group, and probably the best known, is devoted to the study of cosmic rays and is housed at the top of the building. The two most important techniques demonstrated were the production and flying of high-altitude balloons, and the processing and examination of nuclear emulsions, both of which have been greatly advanced as a result of work by the Bristol group. The importance of this work both in the study of the nature of cosmic-ray primaries, and in the investigation of nuclear events at energies higher than can be obtained even with the largest accelerators, is too well known to require elaboration here.

The more routine activities of the Laboratory, such as in the teaching laboratories, workshop and glass shop, were on view and excited considerable interest, and in these matters the Department can congratulate itself on being very well staffed and equipped. As a further diversion to visitors, films were exhibited periodically in the large lecture theatre. These films were made by members of the Laboratory and illustrated work on cosmic rays, glass blowing and crystal growth.

For its growth from small beginnings to its present state, the Laboratory owes an enormous debt of gratitude to Prof. A. M. Tyndall, first holder of the Henry Overton Wills chair of physics (1919–48). In this office he was succeeded by Prof. N. F. Mott (1948–54) and then by Prof. M. H. L. Pryce (1954–). The second professorship, the Melville Wills chair, has been held by the late Sir J. E. Lennard-Jones (1927–32) and Prof. N. F. Mott (1933–48), and the present incumbent is Prof. C. F. Powell (1948–). From time to time a third professor of physics has been appointed—Prof. S. H. Piper (1951–53) and Prof. F. C. Frank (1954–). A recent addition to the distinctions of the academic staff was the election this year of Dr. J. W. Mitchell to the fellowship of the Royal Society.

Comments and letters received from the visitors by the organizers seemed to confirm that the open days, although involving a considerable amount of work, have been successful in bringing the activities of the Laboratory to the attention of its guests in an interesting and agreeable way. D. F. GIBBS

CARNEGIE INSTITUTION OF WASHINGTON

REPORT FOR 1954–55

YEARBOOK No. 54 of the Carnegie Institution of Washington* covers the year July 1, 1954–June 30, 1955, including Dr. Vannevar Bush's final report as president and the reports of departmental activities and co-operative studies, with a bibliography of publications of the Institution and of the president in addition to those appended to the departmental reports. At the Mount Wilson and Palomar Observatories two major studies of the Andromeda nebula were completed during the year: an intensive study of the high-luminosity variables, including the cepheid, the long-period, the semi-regular and the irregular types; and a systematic search for novæ during two observing seasons, in which the detailed light curves of thirty novæ were measured and, for the first time, definitive statistical information was obtained on the absolute luminosities at maximum, types of light curve and the frequency of these novæ. A third major project was the establishment of a precise, photoelectrically determined magnitude-scale, extending down to the faintest observable stars in several areas distributed in such a way that at least one of the areas is always visible in the night sky for comparison. The project has now provided standards for use throughout the range of the Hale telescope. The programme concerned with setting up photoelectric standard-magnitude sequences has also been completed, and the study of the internal motions in planetary nebulæ continued, as well as spectroscopic observations of the Cassiopeia radio source and a spectroscopic observation of the colliding pair *NGC* 1275 in the Perseus cluster of galaxies. A new grating spectrograph was put into service at the Cassegrain focus of the 60-in. telescope, and a new stellar template magnetometer is being developed to increase the efficiency of observations of stellar magnetic fields, depending on the use of a template of the spectrum of the star to be investigated.

The Joint Committee on Image Tubes for Telescopes is attempting to develop a promising type of image converter for mass production, in which a very thin film is stretched across the end where the phosphorescent screen would otherwise be located; this film permits the electronic image to be formed astride the tube while the high-quality vacuum is preserved. An attempt is also being made to develop a special type of thin-film converter capable of withstanding full atmospheric pressure, thus avoiding the complications of the vacuum charger required in the first converter.

The Department of Terrestrial Magnetism, using the 'Mills cross' array of antennæ, has made the interesting and unexpected discovery of a variable 22-Mc./s. source of small dimensions in the constellation Taurus. A comprehensive series of measurements on the distribution of hydrogen clouds in several sectors of our galaxy indicates that our solar system is near the inner edge of a local arm, and that this arm is not circular about the centre of the galaxy but is strongly inclined. Observations have also been made on the intensity distribution of the emission from the 'quiet' Sun and on the low-frequency radio emission from several of the most intense sources in the sky, with the view of differentiating between thermal and other possible mechanisms producing these radiations. In a seismic expedition to the Rocky Mountains in the summer of 1954, unequivocal evidence was obtained that the sharp boundary between the crust and mantle of the Earth lies at the same depth under the Colorado Plateau in Arizona and New Mexico as under the coastal plain in Maryland and Virginia, and later in the summer the same result was obtained under the mountains of Utah. Encouraging progress was made in determining the extent to which the history of the changes in the Earth's magnetic field can be traced in geological time, and an expedition to Arizona and New Mexico showed that the rocks of the south-west of the United States give about the same location for the magnetic pole in Permian time as is indicated by the rocks of Great Britain. In the programme of isotope dating for ancient minerals, age studies of minerals in the Quartz Creek (Colorado) area have demonstrated a pattern of consistency among the rubidium–strontium ages and also among the potassium–argon ages of the micas from this region. Studies have also been made of toroidal magnetic fields in the ionosphere, of the daytime enhancement of the initial phase of magnetic storms at Huancayo, and the investigation of nuclear energy-levels by the

* Carnegie Institution of Washington. Year Book No. 54 (July 1, 1954–June 30, 1955), with Administrative Reports through December 9, 1955. Pp. xxxix+9+311+3 plates. (Washington, D.C.: Carnegie Institution of Washington, 1956.) Cloth, 1.50 dollars; paper, 1 dollar.