THE NATIONAL PHYSICAL LABORATORY

ANNUAL INSPECTION

REPRESENTATIVES of industrial organisations, university staffs and leading Government men of science were once again invited to inspect the work which is in progress during the National Physical Laboratory's 'open days', June 18–20. This second post-war exhibition followed the annual inspection by the Laboratory's General Board, of which the president of the Royal Society is chairman. Altogether, 264 exhibits were on show, illustrating the variety of work undertaken in the Laboratory's ten Divisions, and during the three days some two thousand people visited the Laboratory.

The National Physical Laboratory has grown steadily throughout its forty-six years of existence and now comprises sixteen large and a number of small buildings on a site of 60 acres. Until 1918, it was under the control of the Royal Society and, although since that date the Laboratory has been part of the then constituted Department of Scientific and Industrial Research, the Society still advises on the scientific aspects of the work.

The main aspects of the work of the Laboratory are the carrying out of research, including especially research required for the accurate determination of physical constants, the establishment and maintenance of precise standards of measurement, and the testing of instruments and materials. It also undertakes investigations of special problems on behalf of Government departments, for research associations representing various industries, and for technical institutions, industrial firms and others.

To describe any considerable number of exhibits in a short article such as this would be impossible, and mention will be made only of those items which are of outstanding general interest or which illustrate some interesting new development.

Of considerable interest to structural engineers is the research being carried out on the wind-induced oscillations of the proposed Severn suspension bridge, the centre span of which will be more than 3,000 ft. in length. The Tacoma Narrows Bridge in the United States, which collapsed in 1940 under torsional oscillation, had a centre span 2,800 ft. long. Dynamic scale models more than 80 ft. in length are being constructed for tests in a large wind tunnel specially built by the Ministry of Transport, and the structural components of these models were on view. In this tunnel, a special turntable will enable tests to be made on the model bridge at all horizontal angles of wind incidence, with wind speeds up to a maximum corresponding to 130 m.p.h. on full scale.

A more stable type of hot-wire anemometer for measuring wind speeds of less than 2 ft. per second has been recently developed at the Laboratory. In this instrument the heater wire and the thermocouple wires are carried in a twin-bore silica tube, which acts as a shield preventing deposition of extraneous matter on the wires. Considerable use has already been made of this instrument in various investigations, and it will find a ready application in such work as the ventilation of mines and buildings.

The Engineering Division had on show the results of work carried out in connexion with the adoption of a new standard thread-form by Great Britain, Canada and the United States. The major portion of this work had been completed in time for the Conference on the Unification of Engineering Standards in Ottawa in 1945, which decided upon the new form of thread to be recommended.

This Division of the Laboratory has given considerable help in the recent development of gas turbines. Work on the development of suitable bearings for use at the very high rotational speeds required, and the investigation of the fatigue and creep properties of various alloys, are of outstanding importance in this respect.

The tidal model work is now concerned with the Firth of Forth, and a model of the estuary has been constructed to a horizontal scale of 1 in 1,800. The main purpose of the investigation is the study of the deposition of silt in the approaches to Rosyth Dockyard, the dredging of which entails considerable expense. A model of the estuary of the River Wyre in Lancashire is under construction for the study of problems connected with the meanderings of the deep-water channel.

In the Electricity Division the determination of the velocity of electromagnetic waves is being made by measuring the frequency of electrical resonance of a hollow copper cylinder. This frequency depends only on the dimensions of the cylinder and the velocity of propagation of the waves, and an error of less than three hundred thousandths of a centimetre in the measurement of the dimensions allows an estimated accuracy of 9 km./s. in the determination of the velocity.

The High Voltage Laboratory had an exhibit illustrating the progress that has been made in the design and construction of an absolute voltmeter for very high voltages. This attracted-disk type of voltmeter will be housed in a compressed gas chamber, and with its development it is hoped to acquire experience of the properties of compressed gases as high-voltage dielectrics.

The quantitative study of the propagation of centimetre waves has required the development of suitable field-strength meters and standard radiators. The equipment displayed was designed for operation at wave-lengths of about 10 cm. and 3 cm., and consists essentially of antennæ of known gain (determined experimentally) relative to a half-wave-length dipole. In this sphere, a knowledge of the dielectric properties of the atmosphere and its constituents is needed for a full understanding of the propagation processes, and apparatus for the measurement of the reflexion and transmission coefficients of water at wave-lengths down to nine millimetres was also on view. The waves are reflected or transmitted through very thin plane sheets of water, and measurements on the effect of salt in solution have enabled a comparison to be made between the properties of sea- and fresh-water.

One of the interesting instruments on view was a photo-electric colorimeter employing an adjustable spectrum template. The three separate curves which measure and express the colour functions of the eye are not exactly the same for every individual, so that it has been necessary to provide an agreed set of average curves, which has been given the status of 'international standard observer'. The instrument consists of a photocell and the means to modify the response to that of the average observer. It has a wider application than the spectrophotometer, being capable of measuring not only absorption on coloured glasses or paper, but also illuminants such as discharge lamps and any colour illuminated by them. The accuracy with which the combination of photo-

cell and colour filter gives the same results as the average eye is being investigated.

During the past year an entirely new section, on control mechanisms, has been added to the Metrology Division. This group has in hand the development of an electro-mechanical differential analyser. This machine will have twenty mechanical integrators and gear systems, interconnected by electrical remote control position servo-mechanisms, which will enable it to be used either as a whole or in sections permitting the simultaneous solving of several problems. A prototype model comprising two integrators was on view. The section is also concerned with the study of the principles of automatic control, and a pilot plant has been designed and constructed for this purpose. Oil is circulated through the plant and its temperature automatically controlled by closed-cycle systems employing the proportional, the floating (or integral) or the first derivative (or rate) method of control. Alternative control methods will also be investigated.

Ternary alloys of iron, nickel and chromium form the basis of numerous commercial alloys for use at service temperatures between 500° and 800° C. It is desirable—in many cases essential—that exposure to these high temperatures should not bring about any micro-structural changes which might be accompanied by a deterioration in the mechanical properties of the alloys. One such possible change is the formation of the brittle sigma phase in alloys of certain compositions when heated within the 500°–800° C. range, and the composition and temperature ranges over which this phase is precipitated in pure iron–nickel–chromium alloys is under investigation in the Metallurgy Division. One of several interesting points shown by this work is the extreme sluggishness of the process by which the sigma phase is formed in alloys containing about 20 per cent chromium, and the effect of increasing proportions of nickel on the sluggishness of the reaction. The indications are that alloys containing about 20 per cent of chromium and not less than 25 per cent of nickel will only attain true equilibrium after many months annealing at temperatures between 550° and 650° C.

Two new induction furnaces to be added to the equipment of the Division will be used in the first place to make alloys for studying the effects of alloying elements on the properties of pure iron. One furnace, designed to melt at least 50 lb. of iron in air, has already been installed, and a second furnace designed to melt 25 lb. of iron *in vacuo* is at present under construction.

The Ship Division, working in close collaboration with the principal shipbuilders and naval architects, is rendering very useful service in solving difficulties with regard to ship-form design, and models of all classes of ships, ranging from 30,000-ton liners to 45-ton launches, are tested in one or other of the two tanks. As a result of such tests, corrections to improve performance are made in the ship and, in many cases, a final check is carried out by staff during an actual voyage. Various pieces of apparatus used in these full-scale tests at sea were on view, and hull-form tests and propulsion experiments were being carried out in the tanks.

Modern requirements as regards comfort in buildings coupled with the necessity for fuel economy have led to an intensive study of the properties of walls, roofs and floors as regards resistance to heat flow. The Physics Division of the Laboratory displayed a wide range of equipment of this nature for dealing with, say, wall-sections weighing half a ton or thin sheeting materials such as wall-boards. Work is also carried out on wall-sections of cavity construction when the external surface is subjected to a daily cycle of radiation simulating conditions in the tropics. The uniform stream of radiation is supplied by a battery of incandescent lamps run at low filament-temperature and mounted in parabolic reflectors.

Since the War, fundamental work on acoustical measurement standards has been recommenced and the section concerned has been largely re-equipped. A new development on view this year was a large acoustic duct in which plane waves of sound are generated to serve for the standardization of microphones at low frequencies and for other experiments involving low-pitched sounds.

One of the sections of the Mathematics Division, that concerned with research into new computing methods and machines, is now engaged in the development of an automatic computing engine, the ACE, and a short lecture on electronic computing machines was given twice on each afternoon during the exhibition. A correlogram calculator constructed at the Laboratory was on view. This instrument is used for calculating serial correlation coefficients direct from a continuous graphical record, and uses three pairs of wheel and disk integrators linked together by an averaging motion.

THE CHEMICAL RESEARCH LABORATORY, TEDDINGTON

REPRESENTATIVES of all elements of the chemical community and including many distinguished foreign men of science have recently visited the Chemical Research Laboratory of the Department of Scientific and Industrial Research. These 'open days' coincided with the centenary celebrations of the Chemical Society, and a large party of fellows of the Society visited the Laboratory on July 17.

The Laboratory, founded in 1925 to provide a centre for the fundamental chemical research carried out in the Department of Scientific and Industrial Research, stands in the same grounds as the National Physical Laboratory. If it has not yet achieved the wide fame of its older and larger sister, it has shown a sturdy growth during its short life and, with the ending of its war-work, is entering upon a period of vigorous activity.

Since the end of hostilities, the Laboratory has been modernized and re-equipped. A large prefabricated building has been erected during the past few months and is in full use. The new building has been named after Stephen Hales, to commemorate this great experimental scientific worker who was, for more than fifty years, vicar of Teddington. Much of the existing building has been overhauled and modified to accommodate new techniques. These include micro-analysis, high-efficiency fractional distillation, spectrography and many more. The existing facilities in such major fields as the corrosion of metals, high-pressure reactions and plastics have been improved and extended.

The buildings contain sixty-five rooms of various sizes, of which eleven are specialist laboratories and three semi-scale laboratories. The Laboratory also has a drawing office, two workshops and a glass-working room manned by skilled staff who are engaged