

The National Physical Laboratory, Teddington.

ANNUAL INSPECTION.

ON Tuesday, June 24, the General Board of the National Physical Laboratory made the annual visitation to the Laboratory. As is usual on this occasion, a large number of members of scientific and technical societies and institutions, members of Government departments and of industrial organisations were also invited to the Laboratory, the whole of which was open for inspection. The visitors were received by Sir Charles Sherrington, chairman of the General Board, Sir Arthur Schuster, chairman of the Executive Committee, and the Director of the Laboratory.

An extensive programme of exhibits had been arranged to illustrate the general character of the work of the Laboratory in addition to features of particular or novel interest.

In the Aeronautics Department the wind channels were shown in operation on various problems which are engaging the attention of the Department. In the 7 ft. wind channel, the airflow round a monoplane aerofoil was being investigated with the object of examining the fundamental assumptions of the Prandtl theory of vortex motion. Special hot wire anemometers, in which the wires are placed along instead of across the air stream, are used to observe the direction and velocity of the air stream. The existence of eddies behind cylinders in an air stream was made evident audibly, by the amplification in a two-valve amplifier and telephone receiver, of the fluctuating potential differences produced by the cooling effects of the eddies, in a hot platinum wire placed behind the cylinder. In the 14 ft. channel, apparatus was on view designed and constructed in the Department for measuring the head resistance of stream line bodies in a wind channel and in the William Froude National Tank. By using the same apparatus in both air and water, the method eliminates the interference between the apparatus and the body under test, so that comparison of the results is possible, and for the first time accurate deductions of the importance of "eddies" in channel work can be made. Other exhibits included the whirling arm and the electrical method of determining the theoretical stream lines for an inviscid fluid moving past a flat plate, both of which were mentioned in the description of the exhibits at the last visitation.

In the Engineering Department, a special electrical dynamometer designed to produce full torque from 20-1700 revolutions per minute was exhibited. The field magnet frame was mounted on roller bearings, and it is claimed that the power transmitted (up to 100 h.p.) is measured to one-tenth of 1 per cent. Another interesting exhibit was that of apparatus for measuring and recording the relative movement of chassis and axles in vehicles. This work has developed in connexion with a general research on springs for vehicle suspension. The effect of shock absorbers in damping vibrations has also been investigated. Apparatus for determining the effect of keys and keyways on the endurance of shafts and for testing brake lining materials was also on view.

In the Metallurgy Department a high frequency induction furnace was shown in which metals can be melted in vacuo without danger of contamination from circumambient gases. The electrolytic preparation of iron and chromium of 99.98 per cent. purity was also on view. In the Wernher Building, interesting microphotographs showed the behaviour of mild steel and brass under the action of cutting tools. These indicated the great importance of the orientation and shape of the tool in determining the ease with

which the metal is cut, the character of the finished surface and the wear on the tool.

In the William Froude National Tank a model 10-knot single-screw cargo steamer was shown under test for propulsive efficiency. The thrust and torque of the propeller and the resistance of the hull in water are measured. The plant for making accurate models of ship hulls of a mixture of paraffin wax and beeswax, and also of screw propellers, was on view, and a model propeller was shown under construction.

In the Metrology Department standard weights, including new weights made of stellite, were shown. Various measuring machines designed and constructed in the Department were also on view. These included the "millionth" comparator and tilting level comparator for the comparison of standard length gauges to an accuracy of a millionth of an inch, an improved travelling microscope and the Blythswood diffraction grating ruling engine. Various methods of the application of interferometry to metrological work were shown together with sources of light producing a series of monochromatic rays covering a wide range in wave-length.

A very large number of exhibits was shown in the Physics Department, including a new form of all-metal mercury vapour pump, capable of extremely rapid exhaustion, and a standard optical pyrometer of the disappearing filament type for use up to 3000° A. The most interesting were in connexion with the sound section, in which a photographic method of studying the acoustical properties of rooms was shown. A vertical section of a model of a building was placed horizontally in a trough of water, and trains of water waves were emitted from a point corresponding to the position of a speaker. By projecting light vertically through the glass bottom of the tank, the shadow picture of the disturbance at the surface of the water could be seen on a screen above. This was photographed at certain definite times, enabling the progress of any wave to be followed in its travel across the model of the room, and in its reflections (echoes) from the walls or architectural details. The results have shown in a very convincing manner how in buildings the structural details can interfere with the propagation of speech in certain parts, and the department has been able to make valuable suggestions to improve the acoustical properties. Experimental sounds are very often produced by electrical methods, and an interesting method of study of the purity of the waveforms of electrical oscillations, which are later transformed into auditory oscillations, has been developed. It involves the use of the Weston cathode ray oscillograph, the spot of which describes a circle on the fluorescent screen if the oscillations are sinusoidal.

The Radiology Section exhibited apparatus for the determination of absorption co-efficients, using a metal X-ray tube of high output, for the rapid determination of the lead equivalent of X-ray protective material, and various apparatus for the determination of the crystal-line structure of metals and alloys, several of which have been worked out and are of great interest in connexion with the collateral work of the Metallurgy Department on the same alloys. In the Optics Section a new flicker photometer for comparing lights of different colours and improved spectrophotometric apparatus were shown. A constant temperature room has been added to the equipment of this section since the occasion of the last annual visitation and should result in the eventual determination of important optical constants to a greater accuracy than has been possible hitherto. The room is cooled by air from a refrigerat-

ing plant or warmed by air passing over electric heaters; cooling or warming to any desired temperature is automatic through electrical resistance thermometers and relays, and maintains the temperature at any point constant to 0.01° C.

In the Electricity Department, Alternating Current Division, the arrangements for the accurate measurement and calibration of A.C. instruments and of high voltage insulating materials were shown. An interesting phenomenon in dielectric hysteresis was exhibited in which a rotating electric field caused a cylinder of celluloid to rotate. The greater the energy loss due to imperfection of insulation quality, the greater is the torque and the speed at which the insulation material will rotate, except that owing to friction the speed cannot reach that of the rotating field (50 r.p.m.). In the Direct Current Division the association of a hydraulic pressure with endosmosis was exhibited. An electric circuit of 100 volts was earthed under a glass funnel full of damp earth surrounded by water. In the experiment shown, the passage of a few milliamperes caused the water to ascend from the earth to a height of 12 ft. in a tube connected to the funnel. The phenomenon is of interest and importance in the choice of the most suitable methods of earthing electrical machinery and power cables.

The Photometry Division showed exhibits illustrative of the careful work and research which is contributing to the improvement of artificial illumination of all kinds. The experimental building for determining the best methods of utilising daylight was also shown in opera-

tion, and a new instrument for measuring daylight factors shown. In the Electrical Measurements Division apparatus showing the accuracy which has been developed in the measurement of frequency in radio oscillations was exhibited. A radio station for the transmission of standardised frequency has been equipped and was open for inspection. In the Wireless Division, apparatus was shown which enables the direction of both the electric and magnetic forces in electromagnetic waves to be determined separately, so that the direction of the wave front is accurately known. This is of interest in connexion with the Beveridge antenna, the action of which is due to the existence of tilt in arriving electromagnetic waves. Among the standard testing apparatus demonstrated were a panel for measuring all the static characteristics of receiving valves, and a set for examining the amplifying properties of audio frequency intervalve transformers. In the latter arrangement the actual voltage amplification produced by a stage comprising one valve and one transformer is measured by a comparative audibility method at any frequency from 250-4000 cycles per second. Using standard types of amplifying valves this measurement enables a study to be made of the frequency distortion introduced into speech-frequency amplifiers by the iron cored intervalve transformers. Other apparatus was shown by which the input and output of any standard type of amplifying detector can be measured, thus enabling a complete study to be made of the behaviour of an amplifier at either radio or audio-frequencies. H. B.

The Natural Resources of Russia.

THE Transactions of the Committee for the Study of Russia's Natural Resources, attached to the Russian Academy of Science, include works of varying type:

(1) Separate monographs—"Precious Stones of Russia," by A. E. Fersman; "A Household Fungus," by I. A. Makrinoff.

(2) Studies of Russia's natural resources—"Russian Wax," by N. M. Koulagin; "Medicinal and Tanin-producing Plants of the Tavricheskaya Province," by B. N. Lioubimenco; "Tea and its Cultivation in Russia," by the same author; "Kendyr (*Apocynum Sibiricum Pall.*)," by I. A. Rajkova; "Russian Sources of Fuller's-earth," by A. E. Fersman; "Beet," by E. V. Kostezky and E. J. Zalensky; "Iodine Containing Lakes of the South of Russia: Eltonskoe, Bakou Iodine Lakes and the Saki Lakes," by N. N. Efremoff, G. G. Ourazoff, and A. E. Fersman; "Bozon," by V. G. Khlopin; "Absorbing Properties of Russian Clays," by P. E. Zamiatchensky; "The Caspian Pilchard," by B. I. Meisner; "Phosphates of the Ukraine," by V. N. Chervinsky; "Tihvin Bauxite," by A. D. Stopkevitch, V. I. Ikskul, and B. P. Ovsiannikoff; "Honey," by I. A. Kabloukoff; "Mica," by I. I. Ginsbourg.

(3) Periodicals—vol. i. of "Wind as Driving Power," by M. M. Rikacheff, A. V. Voznesensky, and T. N. Klado; vol. iv. of "Useful Ores," including: "Silver, Lead and Zinc," by K. I. Bogdanovich; "Gold," by K. I. Bogdanovich, "Vanadium," by K. I. Bogdanovich and K. A. Nenadkevich; "Sulphuric Pyrite," by J. B. Samoiloff; "Russian Coals," with an introduction by P. I. Stepanoff—a co-operative work of 30 specialists of the different coal regions of Russia; "Naphtha and Ozokerite," by D. B. Goloubatnikoff; "Phosphates," by J. B. Samoiloff and A. D. Arhangelsky; "Felspar," by A. E. Fersman; "Ores of Aluminium," by K. K. von Foht; "Selenium," by F. B. Braglia; vol. vi. of

"The Animal Kingdom": "Mammals and Birds," by A. A. Silantieff and E. K. Souvorov; "Fishes," by V. I. Meisner, N. M. Knipovich, V. K. Soldatoff, I. N. Arnold, I. D. Kouznezoff, A. I. Golovkin, and A. J. Nedoshivin; "Cattle," by S. A. Ivanoff; "Poultry," by M. I. Diakoff.

(4) Reports on the Activities of the Committee: Minutes xxvii.-xxxiii., reports on 1918 and also reports from 1915 to 1920; and

(5) News from the different scientific institutions attached to the Committee: Institute for the Study of Platinum and other Rare Metals, Institute of Physico-Chemical Analysis.

All the above-mentioned bulky and valuable material in connexion with the natural resources of Russia has been published since 1918-1920. With exceptional feeling and respect one turns over these pages, written by Russian men of science, with a great love of their country, and in circumstances of the greatest privations. These privations affected not only their personal well-being, but also such things as the possibility of getting necessary scientific literature and reagents, and even the temperature of the laboratories. We can get an idea of the hardships they endure by occasional phrases we sometimes meet in their works. We learn, for example, that the temperature of the laboratory of the Polytechnical Institute in Petrograd was the same as that of the street, because the laboratory could not be heated; that the photographic section of the expedition for exploring the Karabougai Gulf could only make negatives because they had no suitable printing paper and equipment to be able to make use of silver bromide paper, etc. In spite of, or perhaps even because of these awful surroundings, Russian men of science have devoted themselves with praiseworthy neglect of self to their scientific work.

"In the dark and even perhaps seemingly hopeless days of Russian everyday life, I have tried," says