THE NATIONAL PHYSICAL LABORATORY DURING 1911.

THE annual meeting of the General Board of the National Physical Laboratory was held at Teddington on Friday last, March 15. As usual, a large number of visitors were invited to view the Laboratory, and were received by Sir Archibald Geikie, president of the Royal Society and chairman of the general board, and by Lord Rayleigh, the chairman of the executive committee. The visitors were glad to see that the director, Dr. Glazebrook, was sufficiently recovered, after his recent illness, to be able to take part in the proceedings.

The continued development of the work of the laboratory has been well maintained during the past year. The William Froude National Tank was formally opened in July last. The Wernher building, erected, as its commemorative tablet states, by Sir Julius Wernher to advance the science of metallurgy, was completed in the autumn. A new laboratory has been provided, under a scheme approved by H.M. Treasury, to carry out tests for the Road Board on road materials and on experimental road-tracks. Other new buildings are now in course of erection.

It was explained in the report of the Laboratory for the year 1910 that the control of the meteorological work carried out at the Kew Observatory had been transferred to the Meteorological Office. The testing of thermometers, telescopes, watches, and other instruments previously carried on at Kew—the observatory department of the Laboratory—was to be continued there until the necessary accommodation could be provided for the removal of the work to Teddington. The further buildings now under construction will enable this transference to be made. They include an optics section, which will provide space for all the optical work now carried out at Kew and Teddington, leaving room in Bushy House for other portions of the Kew work; and an administration building, with offices, library, &c., and a section for the receipt and despatch of instruments. The need for such a building had become imperative, owing to the great increase in the activities of the Laboratory.

Towards the cost of these new buildings the Treasury will contribute the sum of 15,000*l*. The committee in its report explains that an additional sum of about 10,000*l*. will be necessary for the satisfactory equipment of the buildings, and expresses confidence that the appreciation shown in the past of the national work done by the Laboratory will be continued, and that the help needed will be readily forthcoming.

The most interesting addition to the equipment completed during the past year, and shown in operation on Friday last, is the Lorenz apparatus for the determination of the ohm in absolute measure. Some particulars of this have been given previously. Much attention has been devoted recently to the elimination of the thermal electromotive force at the brush contacts, and with the form of brush finally adopted—annealed phosphor-bronze wires stretched as a bow-string and pressed on the circumferences of the discs—it is found that the desired result has been obtained. A further difficulty, the determination, with the high accuracy necessary, of the distance between the equatorial planes of the coils, has been met by a special device. A light tubular magnet is suspended from an agate knife edge resting in an agate **V**, and swings like a pendulum; its rest-point can be determined as for a weighing balance. This magnetic pendulum is placed inside a coil, and the position for which there is no axial displacement when a current is passed through the coil can be observed within about three thousandths of a millimetre. This method promises to be very accurate, and will appreciably lighten the work of obtaining the measurements. The first determinations of the ohm with the apparatus will, it is hoped, be made very shortly.

An entirely independent method of evaluation of the ohm in absolute measure has been applied by Mr. Campbell. This is one of several methods he has suggested for the comparison of resistance with mutual inductance. An auxiliary condenser is tested against a resistance by Maxwell's commutator method and against a standard mutual inductance and two resistances by Carey Foster's method, the results giving the ohm in terms of the mutual inductance, the value of which is calculated from its dimensions. Though not aiming at so high an accuracy as it is hoped may be attained with the Lorenz apparatus, the method appears to yield very good results.

The photometry division has completed an interesting research on the visibility of point sources of light. The investigation was undertaken, at the request of the Board of Trade, in connection with the certification of ships' lights, which at a distance of two miles are seen simply as bright points of no perceptible angular magnitude. The unit of visible intensity adopted for comparison purposes is that of a point source of one-millionth of a candle-power one metre distant from the eye; this unit approaches the limit of visibility. An important point investigated was an apparently anomalous dimming of lights observed in the case of some persons using spectacles, which was found to be due to the chromatic aberration of the eye.

In the course of the research on the fundamental high-temperature scale in the thermometry division some interesting ionisation phenomena have been met with, recently described before the Royal Society by Dr. Harker and Dr. Kaye. The division has also taken up the determination of the thermal conductivities of heat insulators as used for cold-storage purposes, a subject of much practical importance.

The metrology division has been largely occupied with the necessary work involved in the maintenance of standards, and with test work. The behaviour of the new silica standard metre is being very carefully followed. As in previous years, a number of investigations have been carried out for the Engineering Standards Committee.

In the engineering department a large number of interesting investigations have been completed. Dr. Stanton's research on the effect of wind pressure on structures has been proceeding continuously almost since the date of the opening of the laboratory. The object of the work has been to enable a trustworthy prediction of the wind pressure on a large engineering structure to be made from laboratory experiments on a small model of the structure. The earlier parts of the work were concerned with experiments on small models in an air channel, which were compared later with the results of observations on larger structures in the natural wind. Following this, an attempt has been made to ascertain whether a trustworthy estimate of the total wind pressure over a large structure can be obtained from observations at one point. This work has recently been completed, and it is considered that sufficient data have been obtained to enable a prediction of the wind pressure over an area of several thousand square feet to be made from observations at a single point in the area. There remains the investigation of the more or less exposed nature of the site on the lateral variation of wind-force. For this purpose, permission has been received to make the observations on the Tower Bridge, and this work will be commenced shortly.

The work of the aëronautics division has made good progress; in particular the study of the best forms of aëroplane surfaces, and of the distribution of flow round such surfaces, has been greatly advanced. An opportunity of describing this work will arise later, on the issue of the annual report of the Advisory Committee for Aëronautics.

The metallurgy department was occupied for some considerable time during the autumn with the transference to the new Wernher building. The principal item of research work has been the investigation of the aluminium-zinc alloys, carried out for the Alloys Research Committee of the Institution of Mechanical Engineers.

Mr. Baker, the superintendent of the William Froude National Tank, has carried out a number of investigations, some of which have been already described in these pages. Careful comparisons have been made with Mr. Froude's results at Haslar by tests on models to lines supplied by him, and experiments have also been carried out with a model similar to others tested at Clydebank and Washington. These tests have shown satisfactory agreement, and the national tank is now ready to go forward with general experimental investigations of ship resistances.

In this short summary it is impossible to do more than touch on the many points of interest presented by the work of the laboratory. Enough, however, has been said to show that the laboratory continues fully to justify the appreciation which the great manufacturing firms of the country have displayed of its value to industry.

OZONE AND VENTILATION.

THE Journal of the Society of Arts of February 9 contains a paper by Messrs. Leonard Hill and Martin Flack on "The Influence of Ozone in Ventilation." The authors point out that whilst it is not legally permissible for the carbonic anhydride in the air of a factory to exceed a few parts per 1,000, no harm whatever is caused by breathing air containing up to 4 per cent. of this gas. A similar statement applies to deficiency of oxygen, which does not become important until the proportion falls to 14 or 15 per cent. These conclusions are quite in accord with the fact that, on account of the dead-space separating the lungs themselves from the open air about one-third of the air drawn into the lungs is re-breathed; it is thus quite impossible that a few parts per thousand of carbonic anhydride in the outside air should affect the lungs, in which the percentage is normally about 5 per cent.

Another theory of the ill-effects of bad ventilation is the supposed liberation of organic poisons. This also is probably fictitious, as animals will live and thrive when supplied exclusively with air already breathed by other animals, and containing $3\frac{1}{2}$ per cent. of carbonic anhydride; they are liable to die of suffocation if the air supply is interrupted, or if the percentage of carbonic anhydride rises to 10 to 12 per cent. As an explanation of the discomfort arising from lack of ventilation the authors suggest: (1) the stagnation of the air, resulting in diminished evaporation from the skin, and a consequent sensation of lassitude; (2) the nausea caused by the odour emitted from an imperfectly washed crowd. The value of ozone in ventilation depends largely upon its power of removing this odour; sterilisation is perhaps less important as expired air is practically sterile; infection is conveyed by droplets of saliva, which cannot be removed by ventilation, but soon settle, and may be removed when the room is dusted.

LA HOUILLE BLANCHE.[1]

THE work of the French "Direction de l'Hydraulique" has already been the subject of two articles in these columns (May 7, 1908, and November 25, 1909). On both occasions a tribute was paid to the very effective and thorough manner in which the department was carrying out its systematic investigation into the hydraulic reserves of the mountain ranges of France. The volume now under review is the fourth of the series, and it sustains the favourable impression created by its predecessors. It brings the record of observations down to the end of 1910, completing a period of very nearly eight years since the inception of the department. The service, in so far as it relates to the region of the Alps (which is the only range at present under observation, though the extension of the work to the Pyrenees is impending), is now concentrated under the direction of M. R. de la Brosse, whose former coadjutor, M. R. Tavernier, has become Inspecteur général de l'Hydraulique agricole.

The area of country comprised within the purview of the inquiry amounts to 22,000 square miles, and lies immediately to the south of the Lake of Geneva, extending to the shores of the Mediterranean, and being bounded on the east and west, respectively, by the Italian frontier and the river Rhone. The principal basins are those formed by the tributaries of the Rhone on its left bank between Geneva and the sea, the most noteworthy being the Isère, the Durance, the Var, the Arve, and the Dranse. Gauging stations to the number of 180 have been established in suitable localities, and the total number of gaugings carried out to December 31, 1910, was 3116, of which 726 represent the work of the last twelve months. The greatest number of records taken at any one station amounted to fifty-nine, and the mean for the whole was seventeen.

From the observations two factors, or coefficients, have been deduced. First the mean characteristic discharge, which represents the minimum guaranteed for half the year; and, secondly, the modulus, or arithmetical mean of the discharges corresponding to the daily level. The former of these factors is valuable in computing the industrial trustworthiness of a stream, and the second is an important element in connection with regularisation works. As an instance may be taken the case of the Durance at Rousset, where, during the five years 1905–9, the records show a variation in discharge between 18 and 440 cubic metres per second, giving as mean figures for the whole period a low-water discharge of 20 cubic metres per second, a modulus of 68, and a total annual volume of 2,138,000,000 cubic metres. The mean characteristic discharge, *i.e.*, the minimum on which it is possible to reckon during half the time, is about 46 cubic metres per second.

The motive power in the French alpine region actually harnessed at the present time amounts to 473,000 h.p., dvided approximately as follows:—Metallurgy, 210,000; power and light distribution, 155,000; chemical products, 60,000; paper, cardboard, &c., factories, 30,000; electric traction, 10,000; miscellaneous, 8,000. Other schemes are now projected which will shortly raise the total to something in the neighbourhood of 2,000,000 h.p.

The volume contains one or two useful essays by individual contributors on technical matters connected with the taking of observations, and there are several interesting photographs. Then follows part ii., which

1 Service des Grandes Forces Hydrauliques (Région des Alpes). Compte Rendu et Résultats des Études et Travaux au 31 Décembre, 1910. Tome iv., pp. 556. Annexe i., Cartes. pp. 14+8 cartes; Annexe ii., Nivellements, 33 planches. (Ministère de l'Agriculture, Direction de l'Hydraulique et des Améliorations Agricoles, 1911.)