Developments in Gas Calorimetry.

By Dr. J. S. G. THOMAS.

SECTION 5 of the Gas Regulation Act, 1920, requires that, in certain cases, apparatus for testing towns' gas "shall include a calorimeter for the production of a continuous record of the calorific value of the gas which is being supplied." During the interim period of development of a suitable and satisfactory recorder, the statutory testing of the calorific power of gas has, in accordance with the specification of the Gas Referees, been done in practically all cases by determinations of calorific power made at specified periods with a Boys calorimeter. The cost and elaborate procedure at present necessitated by this method of testing have become a serious burden, particularly in small country places, and with the view of reducing these difficulties Prof. C. V. Boys has designed a simple equipment which he described at the meeting of the Institution of Gas Engineers on June 10 last. The apparatus is illustrated in Fig. 1.

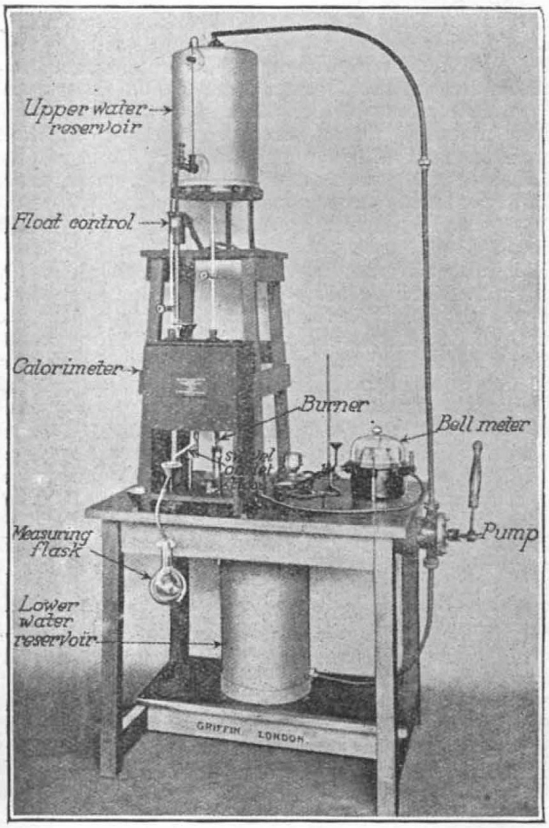

FIG. 1.

Water required for the test is contained in an upper reservoir, and after passing through the calorimeter is received in the tank or lower reservoir below the table, whence it may be restored to the upper reservoir by operation of the handle of the pump, the water entering at the bottom of the upper reservoir, so that by continuing the pumping operation air is forced into the water, the consequent stirring ensuring uniformity of temperature. The customary overflow funnel system for determining the water rate through the calorimeter has been replaced by a float control, resembling a carburettor in design. Water passes from the calorimeter by a swivel outlet tube moving between stops, so that the water may either flow to the lower reservoir or be collected in a measuring flask during the actual test. Prof. Boys has, very reluctantly, been obliged to abandon the use of "onazote" which he employed in the construction of his "Block" calorimeter as a water-containing and insulating material, and has reverted to a construction very similar to that employed in his recording calorimeter (NATURE, August 19, 1922, p. 251) for the water circulation within the present "Box" calorimeter.

Gas to be tested is efficiently governed and passes through a micrometer tap to a Boys "Bell Meter," and thence to a burner consisting of a narrow inner tube terminating within a plain silica tube open above and below. There are no moving gas connexions, and as the gas is somewhat aerated before combustion it is possible to burn as much as one cubic foot per hour without risk of imperfect combustion. Readings of inlet and outlet temperatures of the water passing through the calorimeter may be taken after the burner has been alight about 15 minutes.

The Boys "Bell Meter," shown also in Fig. 2, incorporates some of the essential features of the meter employed in Prof. Boys's recording calorimeter

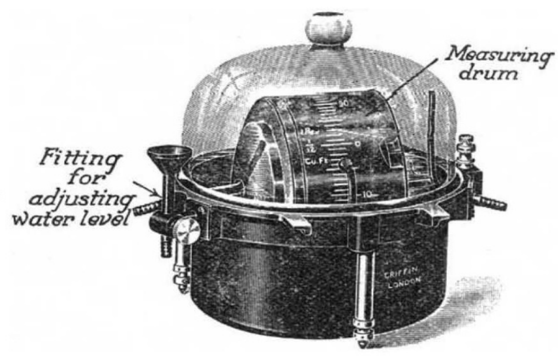

FIG. 2.—Boys "Bell Meter."

(NATURE, *loc. cit.*). A celluloid or nickel drum is graduated along its circumference and is supported on an axle moving in bearings in water, no stuffing box being employed. A buoyancy chamber supports most of the weight of the drum and forms a solid floor to the major part of each compartment of the drum when gas is trapped within it. The water level is determined by a submerged needle. Water may be added to or run off from the meter by means of the fitting seen on the left of Fig. 2. By these means the tiresome operation of meter-proving becomes unnecessary.

In the case more especially of small gas undertakings, where financial considerations unduly limit the number of tests of calorific power of the gas supplied, it is difficult to ascertain the mean value of the gas supplied over the statutory period. The consequence of the present procedure is that small gasworks, in order to prevent an adverse report, have to provide gas which on the whole is of higher calorific value than that declared. Prof. Boys suggests tentatively that in the case of such undertakings the gas supply over any period should be sampled by being slowly and continuously drawn into a small holder in the testing place, maintained if necessary at a uniform temperature, and that the sample so collected should be tested by the Gas Examiner. Owing to the small rate of gas flow and the short time taken, less than half a cubic foot of gas is sufficient for a test. In an apparatus designed by Prof. Boys for such sampling, the gas lifts a balanced bell at a rate controlled by a clock. A chain from the bell to a balance weight made as a sprocket chain passes over a sprocket wheel connected by a clutch to a clock-turned axle, the clutch acting in such a direction that the bell cannot rise faster than the clock permits, whilst it is always free to descend when weighted. This system of clock control of sampling lends itself readily to any agreed scheme of variation of the rate of sampling which may be considered equitable and in accordance with the variation of the rate of gas supply to the district during the hours of day and night. Should experience show that there is no loss of quality due to sampling and storage, the method would ensure one of the most important objects of the Gas Regulation Act being attained.

The Transmission of Excitation in Plants.

THE question of the mechanism of transmission of excitation in plants has been for some time under discussion in the columns of NATURE. The most recent contribution to the discussion is a paper by Sir J. C. Bose, entitled "Physiological and Anatomical Investigations on *Mimosa pudica*," published on August 1 in the Proceedings of the Royal Society (No. B 690, vol. 98).

The first section of the paper is devoted to the vexed question of the nature of the process of transmission. It has been suggested by Prof. Ricca that it is purely physical; a stimulating substance (hormone), produced at the seat of stimulation, is conveyed to the motile leaves by means of the transpiration-current in the vessels of the wood. Another suggestion, that of Mr. R. Snow, is to the effect that whilst Prof. Ricca's explanation may apply to transmission through relatively long distances in the stem, it does not apply to the petiole, where the excitation seems to travel from cell to cell. Sir J. C. Bose arrives at the conclusion that the process of transmission is the same in both stem and petiole; that it is not physical in either, but is wholly physiological, a wave of protoplasmic excitation, just as it is in the nerve of the animal.

The experimental evidence upon which his conclusion is based is both negative and positive. The author failed, after many attempts, to repeat the experiment upon which the transpiration-current theory depends, that is, to observe the transmission of excitation from one piece of stem to another connected with it by a glass tube containing water. Further, if the physical theory be true, it is obvious that the velocity of the transmission of excitation and that of the transpiration-current must be the same; but it was found that the former is far greater than the latter.

On the positive side, Sir J. C. Bose observed that transmission in Mimosa was affected experimentally in the manner well known in animal nerve. For example, in both the velocity of transmission is increased by rise of temperature and by desiccation. Again, on passing a moderately strong electric current (6 volts) through a length of the stem, the effect at "make" of the current was observed, by the fall of adjacent leaves in one direction, to be stimulation at the cathode; on breaking the current, stimulation was induced at the anode, evidenced by the fall of leaves in the opposite direction. It was further demonstrated that transmission is arrested by an electrotonic block; that is, excitation cannot travel along a tissue through which a constant electric current is being maintained. These results, obtained equally with stem and petiole, go to prove that excitation is transmitted in the plant in essentially the same manner as it is in the nerve of the animal.

The remaining sections of the paper deal mainly with anatomical details. The conclusion is reached that the phloem is the tissue that conducts excitation; not the sieve-tubes, but the elongated tubular cells of which the phloem mainly consists. Moreover, evidence is adduced that a strand of these tubular cells occurs also on the inner surface of each xylem-bundle, and this strand is termed the "internal phloem." The results of anatomical observation agree with those of physiological investigation by means of the electric probe. When the probe was inserted gradually into the petiole, maximum negative galvanometric deflexion was manifested when it penetrated the external phloem and again when it reached the internal phloem.

The paper concludes with a comparative study of the pulvinus, from which it appears that the more excitable the pulvinus the more deeply does the protoplasm of its contractile cells stain with safranin; it also reduces osmic acid, indicating the presence of a readily oxidisable substance, not a fat or a lipoid, which is probably concerned in developing the energy required for the active contraction of the organ.

Earthquake Investigation in the United States.

AS already mentioned in NATURE of April 25, p. 615, an act of the United States Congress was approved early this year, enacting "that the Coast and Geodetic Survey is hereby authorised to make investigations and reports in seismology, including such investigations as have been heretofore performed by the Weather Bureau." The reasons for the change and the work that it is hoped to accomplish are given in an excellent popular account (U.S. Coast and Geodetic Survey, Serial No. 304, price 10 cents) by Mr. E. Lester Jones, the director of the Survey.

In 1899, the Coast and Geodetic Survey developed a plan for the magnetic survey of the United States, and five observatories were established in places that proved to be admirably adapted for earthquake observations. Of these places—Porto Rico, Maryland, Arizona, south-east Alaska and Hawaii—three are in major earthquake zones and one near such a zone. As in other places, it was found that the magnetic instruments recorded certain kinds of earthquake waves, and they were supplemented by seismographs which have been in action for more than twenty years. In 1906, after the Californian earthquake, the Weather Bureau installed seismographs at Chicago, Washington and Northfield (Vt.), but, after a time, it was found that seismological investigation, and especially the instrumental part, did not fit in well with the work of the Weather Bureau, nor did the Coast and Geodetic Survey feel justified in attending to seismographs merely as an adjunct to its magnetic work. Accordingly, by agreement of the Secretaries of Agriculture and Commerce, Congress was asked to enact the legislation referred to above.

In several ways, the ordinary work of the Coast and Geodetic Survey is adapted for earthquake investigations. The routine of operating magnetic