country, the fisheries. Much has already been done in Canada in the matter of the propagation of food fishes, but much yet remains to be done in investigating the conditions of the fisheries of both salt and fresh waters, and it may now be anticipated that before many years an important basis of fact will have been built up upon this subject.

One important line of inquiry must yet be mentioned in which no systematic beginning has been made, either under the auspices of the Government or by any society or institution especially devoted to it. This is the field of ethnology, which in Canada is a very extensive one, and which calls for immediate effort, inasmuch as the native races, with which this study is concerned, are either rapidly passing away or are changing from their primitive condition.

Ten years ago, the Council of the British Association was so much impressed with the urgency of investigations of this kind, that it not only appointed a committee to deal with the subject, but has since given each year a substantial grant from its own funds in aid of this work. The Canadian Government for several years supplemented this grant, and eight reports, filled with valuable observations on the western tribes, have so far, as a result of this action, been published in the annual reports of the Association. It has been decided, however, that the functions of the committee, with the grant accorded by the Association, shall cease this year, so that if further progress is to be made, the matter must now be taken up by the Canadian Government. It is earnestly to be desired that the Government may at least contemplate the attachment, either to the Indian Department or to some other department, of a properly qualified ethnologist, by whom these investigations may be continued.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 6, 1894.—"Experimental Researches on Vegetable Assimilation and Respiration. No. I. On a New Method for Investigating the Carbonic Acid Exchanges of Plants." By F. F. Blackman, B.Sc., Demonstrator of Botany in the University of Cambridge.

This paper consists of a description of a complicated apparatus for the estimation of very small amounts of CO_2, which is especially adapted for biological research.

By its aid the evolution of CO_2 by a single germinating seed, or by a small area of a foliage leaf, can be accurately estimated from hour to hour without a break, for any desired time, while for the same area of leaf the more active absorption of CO_2 in assimilation can be easily determined for such short periods of time as fifteen minutes, and that at the same time separately for the two surfaces of one and the same leaf area. Further, for the purposes of this assimilation, air containing any proportion of CO_2, however small, can be supplied continuously to the tissue under investigation. The apparatus is practically in duplicate throughout, and strictly comparative double experiments can be performed.

The experiments are carried out in a continuous current of air at atmospheric pressure; the actual estimation of the CO_2 is accomplished by leading this through baryta solution, of which only a small quantity is used in each case, and the whole of it afterwards titrated *in situ* in the absorption tube, to which only air freed from CO_2 is otherwise admitted.

The following communication illustrates the applicability of this apparatus to the investigation of minute quantities of carbon dioxide:

No. II. "On the Paths of Gaseous Exchange between Aerial Leaves and the Atmosphere."

Conclusions.—(1) That if the amounts of CO_2 evolved in respiration by the two surfaces of any leaf area be determined, it will be found that there is a very close relation between these amounts and the distribution of the stomata. In those leaves with no stomata on the upper surface, practically no CO_2 is exhaled from that surface, and all escapes from the lower surface. When stomata occur equally on the two surfaces the amounts of CO_2 exhaled are equal on the two surfaces, and so on.

(2) Similarly with assimilation, no CO_2 is absorbed by an astomatiferous leaf surface, and when stomata occur on both surfaces, then the amounts absorbed follow the ratios of stomatic distribution.

(3) Boussingault's experiments on the assimilation of leaves with blocked stomata, which have hitherto formed the mainstay of the "cuticular" absorption theory, are completely vitiated by having been performed in super-optimal percentages of CO_2. Their interpretation is exactly the reverse of that usually accepted.

(4) The exhalation of CO_2 in bright light by a leafy shoot in Garreau's well-known experiment, is not the expression of any physiological truth for the leaf, but is only due to the presence of immature parts, or of tissues not sufficiently green, or not fully illuminated. Mature isolated green leaves fully illuminated assimilate the whole of their respiratory CO_2, and allow none to escape from them.

December 13, 1894.—"The Influence of the Force of Gravity on the Circulation." By Prof. Leonard Hill, M.B.

The chief results of the research are contained in the following conclusions:—

(1) That the force of gravity must be regarded as a cardinal factor in dealing with the circulation of the blood.

(2) That the important duty of compensating for the simple hydrostatic effects of gravity in changes of position must be ascribed to the splanchnic vaso-motor mechanism.

(3) That the effects of changing the position afford a most delicate test of the condition of the vaso-motor mechanism.

(4) That the amount of compensation depends largely on individual differences.

(5) That the compensation is far more complete in upright animals such as the monkey, than in rabbits, cats, or dogs, and, therefore, is probably far more complete in man.

(6) That in some normal monkeys over-compensation for the hydrostatic effect occurs.

(7) That in the normal monkey and man gravity exerts but little disturbing influence, owing to the perfection of the compensatory mechanism.

(8) That when the power of compensation is damaged by paralysis of the splanchnic vaso-constrictors, induced by severe operative procedures or by injuries to the spinal cord, by asphyxia, or by some poison such as chloroform or curare, then the influence of gravity becomes of vital importance.

(9) That the feet-down position is of far greater moment than the feet-up position, because when the power of compensation is destroyed the blood drains into the abdominal veins, the heart empties, and the cerebral circulation ceases.

(10) That, generally speaking, the feet-up position occasions no ill consequence.

(11) That the horizontal and feet-up positions at once abolish the syncope induced by the feet-down position by causing the force of gravity to act in the same sense as the heart, and thus the cerebral circulation is renewed.

(12) That firmly bandaging the abdomen has the same effect. While the heart remains normal, and so long as the mechanical pressure is applied to the abdominal veins, the blood pressure cannot possibly fall.

(13) That if the heart is affected, as by chloroform or curare poisoning, the restoration of pressure is incomplete, and it is possible that the heart may be stopped altogether by the inrush of a large quantity of blood, caused by too rapid an application of pressure on the abdomen. More work would be thrown upon the heart than, in its impoverished condition, it could perform.

(14) That vagus inhibition and cardiac acceleration are subsidiary compensatory mechanisms in the feet-up and feet-down positions respectively.

(15) That chloroform rapidly paralyses the compensatory vaso-motor mechanism, and damages the heart.

(16) That ether, on the other hand, only paralyses the compensatory vaso-motor mechanism very slowly and when pushed in enormous amounts.

(17) That the vaso-motor paralysis induced by these anæsthetics lasts for some considerable time after the removal of the anæsthetics.

(18) That chloroform can, by destroying the compensation for gravity, kill the animal, if it be placed with the abdomen on a lower level than the heart.

(19) That elevation or compression of the abdomen immediately compensates for the vaso-motor paralysis produced by chloroform.

(20) That compression or elevation of the abdomen, coupled with artificial respiration and with squeezing of the heart through the thoracic walls, is the best means of restoring an

animal from the condition of chloroform collapse. That these results agree entirely with McWilliams', and are opposed to those of the Hyderabad Commission.

(21) That the feet-down position inhibits respiration, and the feet-up position accelerates it.

(22) That these respiratory results probably depend upon the stimulation of sensory nerve endings by changes of tension brought about by the alterations of position, because the results are abolished by dividing the vagi.

(23) That in the feet-down position the respiration is thoracic in type, and the abdomen is retracted; in the feet-up position the respiration is diaphragmatic and the abdomen freely expanded.

(24) That these types of respiration tend to compensate for the effects of gravity on the circulation, for the retraction of the abdomen in the feet-down position mechanically supports the abdominal veins, whilst the thoracic inspirations aspirate blood into the heart. In the feet-up position the full and free expansion of the abdomen withdraws all obstacles to the compensatory dilatation of the abdominal veins.

In the last part of the paper the medical aspects of this research are discussed. It is suggested that emotional syncope is due to paralysis of the splanchnic area, and a case is quoted where compression of the abdomen immediately removed the syncopal condition. The same treatment, or that of elevation of the abdomen, is suggested for conditions of shock, chloroform collapse, and after severe hæmorrhage.

Finally, a parallel is drawn between some of the results of this research in reference to monkeys and those obtained by Dr. George Oliver on man, by measuring the diameter of the radial artery with his ingenious instrument, the arteriometer.

Physical Society, December 14, 1894.—Prof. W. E. Ayrton and Mr. H. C. Haycraft communicated a paper on a students' simple apparatus for determining the mechanical equivalent of heat. Mr. Haycraft, who read the paper, explained that the object at which the authors had aimed was the construction of an apparatus which could be placed in the hands of junior students, and by means of which a result correct within one per cent. could be obtained, without the introduction of troublesome corrections. The method employed is the electrical one, and the measurements to be made are (1) the value of the constant current passed through the resistance, as given by a direct-reading ammeter; (2) the average value of the P.D. between the terminals of the resistance, as given by a direct-reading voltmeter; (3) the mass of water heated *plus* the water-equivalent of the containing vessel, resistance-coil, and stirrer; (4) the rise of temperature of the water; (5) the time during which the current is passed. Of these the measurements (1) (2) (3) can be effected without the introduction of an error anything like as great as one per cent. The case of (4) and (5) is different. The rise of temperature, to be measured with accuracy, should be fairly considerable, and the same remark applies to the time of heating as measured by an ordinary stop-watch. At the same time, if these two quantities are made unduly great, there will be too great a ratio of heat lost to heat generated during the experiment. The authors consider that, with a given amount of electrical power available, the best conditions will be obtained by making the percentage accuracy of the temperature measurement, the percentage accuracy of the time measurement, and the percentage of generated heat lost by surface cooling equal. Hence they determine the mass of water to be used and the time of heating which may be expected to give the best results. The immersed conductor is a strip of manganin about 0·25 inch wide, 0·03 inch thick, and 5 feet long, which is bent into a series of zig-zags, so as to form a kind of circular gridiron, the successive portions of strip lying all in one plane, and the whole being held rigid by a strip of vulcanised fibre, to which each portion of the strip is screwed. Another precisely similar grid is placed 3 inches below the first, and the two are joined in series, and are mechanically connected together by thin vulcanite pillars. The water is contained in a glass beaker of just sufficient diameter to take the framework of manganin strip. This latter exposes a considerable surface (about 400 sq. cm.) to the water, and is moved bodily up and down during the experiment, thus constituting an efficient stirrer. To allow sufficient freedom of movement, electrical connection is made by means of very flexible leads, each made up of about 210 thin copper wires. The results obtained by students for the heat equivalent of the watt-second have an average deviation from the mean, if several experiments are made, of less than one-half per cent.; and they agree with the best standard determinations within one per cent. Mr. Griffiths thought it inadvisable to provide junior students with apparatus from which every source of error had been eliminated; they were thus led to underrate the difficulty of an experiment, and the care required to obtain reasonable accuracy. Prof. Carey Foster agreed, generally, with Mr. Griffiths, and deprecated the use of direct-reading ammeters and voltmeters in experiments of this kind. He thought it preferable that a student should learn to reduce instrumental readings to absolute measure for himself. Prof. S. P. Thompson dissented from the opinions expressed by the two previous speakers, and thought it was an advantage to students to have the use of direct-reading instruments. Dr. Sumpner described a simple method which he had employed for measuring the mechanical equivalent of heat, and which depended on the heating of a stream of water, as it flowed through a pipe containing the current-conductor. Prof. Rücker was inclined to take an intermediate view of the questions that had been raised. He thought that students should take for granted as little as possible concerning their instruments; but to verify every point, even if practicable, would occupy a great deal of time which might otherwise be more profitably employed. Prof. Ayrton replied, and explained that the calibration of ammeters and voltmeters would be part of the work of a student at another part of his course.—A paper by Prof. Ayrton and Mr. E. A. Medley, entitled "Tests of glow-lamps, and description of the measuring instruments employed," was commenced by Mr. Medley, the latter part of the paper being held over till next meeting. The object of the investigation was to find at what E.M.F. glow-lamps could be most economically run. Too low an E.M.F. gives a low efficiency, and too high an E.M.F. renders the lamps short-lived; so that there must be (for a given lamp) a certain E.M.F. which is more economical to work at than any other. It was also pointed out that, as glow-lamps deteriorate and become less efficient with use, it may be an economy to discard a lamp before the filament actually breaks. The lamp is then said to have reached the "smashing point." Accumulators were used to drive the lamps, automatic apparatus being used to keep the E.M.F. constant, and when a lamp-filament broke, the fact was automatically recorded on a tell-tale.

Geological Society, December 19, 1894.—Dr. Henry Woodward, F.R.S., President, in the chair.—The Lower Greensand above the Atherfield Clay of East Surrey, by Thomas Leighton. This paper embodies the results of the author's examination of the Lower Greensand of East Surrey during the three years 1892–94. The area discussed in the paper extends from Leith Hill in the west to Tilburstow Hill in the east; and the divisions of the Lower Greensand chiefly referred to are those hitherto known as the Bargate, Sandgate, and Hythe beds. The author stated that the Lower Greensand of East Surrey shows that formation to consist of beds deposited in a marine estuary or narrow sea, not far from land and within the influence of strong currents, extending generally from N.W. to S.E., so that, without palæontological evidence, no correlation of beds here with those exposed at Sandgate and at Hythe is possible. He arrived at this conclusion by following the outcrop of the various chert-beds, which, after Dr. G. J. Hinde (*Phil. Trans. Roy. Soc.* vol. clxxvi. 1885), are accepted as of sponge origin (deep-water deposits), and further by following the outcrop of the pebble-beds, described by Mr. C. J. A. Meyer (*Geol. Mag.* for 1866, p. 15).—On the eastern limits of the Yorkshire and Derbyshire or Midland coalfield, by W. S. Gresley. The author attempted to throw light on the question of the easterly extension of the Yorkshire, Derbyshire, and Nottinghamshire coalfield beneath the newer rocks. He noticed the general trend of the strata, the sizes of other British coalfields, the question of the origin of mountains, stratigraphical considerations, and the faults of the North of England.—On some phases of the structure and peculiarities of the iron ores of the Lake Superior region, by W. S. Gresley. The author has studied heaps of ore brought from the region lying south-west of Lake Superior since 1890. He described certain structural features of the ore-fragments, and discussed the evidences of mechanical movements and chemical alteration exhibited by these fragments.

Chemical Society, December 6, 1894.—Dr. Armstrong, President, in the chair.—The relative behaviour of chemically prepared and of atmospheric nitrogen in the liquid state, by James Dewar, F.R.S.—On the use of the globe in the study of crystallography, by J. Y. Buchanan, F.R.S.—A new method of obtaining dihydroxytartaric acid, and the use of

this acid as a reagent for sodium, by H. J. H. Fenton.—Essential oil of hops, by Alfred C. Chapman.—Interaction of 1 : 2-diketones with primary amines of the general formula $R'.CH_2 NH_2$ (second notice), by Francis R. Japp, F.R.S., and W. B. Davidson.—The isomeric dinitrodiazoamidobenzenes and their melting-points, by R. Meldola, F.R.S., and F. W. Streatfeild.—On the yellow colouring matter of *Sophora japonica*, by Dr. Edward Schunck, F.R.S.

PARIS.

Academy of Sciences, Dec. 24, 1894.—M. Lœwy in the chair.—On two invariant numbers in the theory of algebraical surfaces, by M. Emile M. Picard.—Displacement of carbon by boron or silicon in fused cast-iron, by M. Henri Moissan. Carbon is displaced by boron or silicon in a fused iron carbide or cast-iron much in the same way that salts will displace each other from aqueous solution. A state of equilibrium is set up between the iron carbide on the one hand, and the iron boride or silicide on the other hand.—On the circulation of the lymph in the small lymphatic vessels, by M. L. Ranvier.—On the importance of hybridisation in connection with the re-establishment of vineyards, by M. A. Millardet.—The Secretary announced the death of P. François Denza, Director of the Vatican Observatory (died December 14).—The elements of the planet 1894 BE, by M. J. Coniel. Provisional elements for the planet BI, by M. Capon. The planet BE is the most favourably situated, among the known planets, for the determination of solar parallax. The planet BI is identical with (369) of the *Annuaire du Bureau des Longitudes*.—Observations of Encke's comet and of the planets BH and BI, made at Algiers Observatory, by MM. Rambaud and Sy.—Observations of Encke's comet, made at Lyons Observatory, by M. G. Le Cadet.—Observations of the sun, made at Lyons Observatory during the third quarter of 1894, by M. J. Guillaume.—On the problem of three bodies. M. F. Siacci calls attention to his paper on this subject dated January 12, 1874. He remarks that a paper of August 27 (*Comptes rendus*, 451), "Sur la transformation des équations canoniques du problème des trois corps," is a reproduction of his 1874 paper.—Remarks on the matter of a priority claim made by M. O. Staude, by M. P. Staeckel.—On the solution of numerical equations by means of recurring series, by M. R. Perrin.—On a doctrinal point relative to the theory of multiple integrals, by M. Jules Andrade.—On the *abaques* for 16 and 18 variables, by M. A. Lafay.—On the electrostatic capacity of a line traversed by a current, by M. Vaschy. The capacity per unit of length of a cable traversed by a permanent current has the same sense as in electrostatics. With rapidly varying currents, it cannot be supposed that the electric field admits of a potential, hence the notion of a definite capacity disappears.—Electric potentials in a liquid conductor in uniform movement, by M. G. Gouré de Villemontée. At speeds of 33 to 323 mm. per second, the uniform movement of a liquid conductor traversing wide glass tubes of uniform section, does not produce any appreciable difference of potential between two points in the liquid.—Experimental researches on radiation at low temperatures, by M. Raoul Pictet. This is an abstract containing a series of curves showing the variation of radiation with time, and a discussion of these curves.—Contribution to the study of atmospheric ozone, by M. J. Peyron.—On the metallic sulphides, by M. A. Villiers.—Combinations of hexamethyleneamine with silver nitrate, chloride, and carbonate, by M. Delépine.—On the cyano-ethers, by M. Albert Colson.—On the chromates of iron, by M. Charles Lepierre. The author has obtained thirteen chromates, of which two only were known before. Whether prepared from ferrous or ferric salts, all contain ferric iron. All are coloured. They form a series parallel to the basic sulphates of iron.—A new reagent allowing the demonstration of the presence of hydrogen dioxide in green plants, by M. A. Bach. A solution as made containing 0·03 gram of potassium bichromate and five drops of aniline per litre. 5 c.c. of this solution give a violet colouration with two drops of a 5 per cent. solution of oxalic acid only after 36 hours. The colouration is given in the presence of hydroxyl in from 10 to 30 *minutes*. This reagent allows the detection of one part of hydroxyl in 1,400,000. The method of testing green plants is given in detail, and a list of a number of plants showing the reaction is added.—On the valency of glucinum (beryllium) and the formula of glucina, by M. Alph. Combes. β diketones, particularly acetylacetone, form metallic derivatives but yield no acid or basic salts. These derivatives are generally well adapted for determining their molecular weights, and hence the valency of the contained metallic radical. By means of a determination of the vapour density of glucinum acetylacetonate, it is found that glucinum is divalent, and its oxide must be written Be O.—On the constitution of the aromatic sulphones, by MM. L. Zorn and H. Brunel.—On the cephalic lobe of the Euphausinæ, by M. Émile G. Racovitza.—On the development of the kidney and the general cavity in the Cirripedes, by M. A. Gruvel.—On the functional differences between normal and enervated muscle, by M. N. Wedensky.—On the biological relations between *Cladochytrium viticolum*, A. Prunet, and the vine, by M. A. Prunet.—On a detailed botanical chart of France, by M. Ch. Flahault.—On a peculiar method of dehiscence of the pollen of the fossil Dolerophyllum, by M. B. Renault.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Woman's Share in Primitive Culture: Dr. O. T. Mason (Macmillan).—Conspectus Floræ Africæ: T. Durand and H. Schinz, Vol. v.: (Dulau).—Standard Methods in Physics and Electricity Criticised, and a Test for Electric Meters proposed: H. A. Naber (Tucker).—Webster's Practical Forestry: A. D. Webster, 2nd edition (Rider).—Pithecanthropus Erectus eine Menschenaehnliche Uebergangsform aus Java. E. Dubois (Batavia, Landesdruckerei).—A Dictionary of Birds: A. Newton and H. Gadow, Part 3 (Black).—American Spiders and their Spinning Work: Dr. H. C. McCook, Vol. 3 (Philadelphia Academy of Natural Sciences).—Zoological Record, 1893, edited by D. Sharp (Gurney).

PAMPHLETS.—Om Gula Fleberns Spridningssätt: Dr. E. Åberg (Stockholm).—Sur la Transmission de la Fièvre Jaune: Dr. E. Åberg (Stockholm).—Sulle onde Elettromagnetische, &c.: Prof. A. Righi (Bologna).—Versuch einer Theorie der Eletrischen und Optischen Erscheinungen in Bewegten Köpern: Prof. H. A. Lorentz (Leiden, Brill).—Die Form des Himmelsgewölbes: W. Filehne (Bonn).—Blackie's First Stage Mathematics, Euclid and Algebra (Blackie).

SERIALS.—English Illustrated Magazine, January (198 Strand).—Good Words, January (Isbister).—Sunday Magazine, January (Isbister).—Journal of the Chemical Society, December (Gurney).—Zeitschrift für Wissenschaftliche Zoologie, lviii. Band, 4 Heft (Williams).—Economic Journal, December (Macmillan).—Mathematical Gazette, No. 3 (Macmillan). Chambers's Journal, January (Chambers).—Longman's Magazine, January (Longmans).

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