THURSDAY, DECEMBER 28, 1905.

THE CHEMISTRY OF PLANTS.

Biochemie der Pflanzen. Zweiter Band. By Prof. Dr. Fr. Czapek. Pp. xii + 1026. (Jena: Gustav Fischer, 1905.) Price 25 marks.

THE first volume of this work was reviewed some months back (NATURE, June 22, 1905, vol. lxxii. p. 169), when its general scope and nature were given, and certain remarks were made with respect to its style and structure which are equally applicable in the case of the second volume; hence no recapitulation of these is here necessary.

The material of the present volume is roughly double that of the first, and its magnitude is gauged by the number of the pages given above.

As the first volume dealt with the distribution, metabolism, and metastasis of aliphatic substances, so the second deals with proteinic compounds and the biochemistry of nitrogen, with derivatives of closed rings, and with the inorganic constituents of plants; further, the resorption of oxygen, and phenomena of irritability regarded in their biochemical aspect, also receive detailed attention.

The contents of the volume are divided into thirty-eight chapters, which are followed by addenda and corrections, an index of the subject-matter, another of the names of plants, and finally a list of misprints and errata.

The book opens with a chapter on the general chemistry of proteins. The succeeding chapters are grouped, more or less, into sections under the following headings:—the proteinic metabolism of the Fungi and Schizomycetes, that of seeds and of other organs and groups of plants, the ultimate nitrogenous and anitrogenous products of metabolism, the resorption of oxygen, pigments, ubiquitous cyclic and acyclic compounds, the metabolism of inorganic substances, and lastly the stimulatory action of various bodies.

The opening chapter gives a suitably condensed and, as regards the main outlines, comprehensive account of the chemical and physical properties of proteins and the products of their decomposition. In the succeeding two sections the nature of the proteins occurring in different plants and different organs is discussed, and an account is given of the modes in which these compounds are synthesised and rendered available for metabolic processes when external to the plants. The absorption of soluble nitrogenous compounds is also considered in these sections, which are, in fact, concerned with the general metabolism of nitrogenous substances throughout the vegetal kingdom.

In the next section the ultimate nitrogenous products of metabolism are discussed in detail under the following headings:—oils, purine-bases, nitril-glucosides, bases derived from pyridine and chinoline, and derivatives of indol.

The section devoted to resorption of oxygen deals biochemically with ordinary respiration and the acquisition of chemically-bound oxygen.

Following the sections devoted to pigments, substances of universal occurrence, and the ultimate anitrogenous products of metabolism, is an exhaustive treatment of the metabolism of inorganic constituents in various divisions and organs of plants, and of the modes of their occurrence.

The text concludes with an interesting and well-written account of the stimulatory action of various substances in relation to different vital processes such as fermentation, respiration, photosynthesis, protoplasmic streaming, nuclear division, growth, reproduction, &c.

An idea of the degree of comprehensiveness and detail of the work is afforded by the titles of some of the minor chapters, namely, the proteinic metabolism of pollen-grains, that of fruits, of mosses, of algæ; the inorganic metabolism of subterranean reserve-organs, the inorganic constituents of buds, those of wood, of bark, of algæ, of pollen-grains, of fruits.

The main outline of this volume may be said to have been given in the preceding paragraphs.

What appears most striking here, as in the first part, is the colossal amount of material collected; the labour involved must have been enormous. A result of this is the resemblance of the text of many pages to some highly-condensed abstract, as it is in such places practically a long succession of facts—or reputed facts.

Like the first volume the second is singularly free from misprints and errors of nomenclature. But one scarcely expects to read in a precise botanical work—as on p. 818—of the "stem" and "leaf" of Laminaria, a plant that has neither stem nor leaf. Moreover, in no case has Prof. Czapek attached to the name of a plant that of its author; this omission is certainly a common one in botanical works, but in spite of this most deplorable, since in many cases in which this index fails the nature of the plant is doubtful.

Many useful tables of figures occur throughout the work, and orientation with respect to groups of chemically-allied substances is much facilitated through the interpolation of numerous graphic formulæ in the text.

The literature dealing with the subjects treated seems to have been searched with considerable thoroughness, and that which is most essential referred to in relatively suitable proportion. Possibly those who have made the various branches touched upon their special study might detect important omissions, but so far as lay in the power of one man Prof. Czapek seems to have been very successful in citing all that is most important. The reviewer misses reference to Schjerning's important paper on proteohydrolysis that appeared about three years back in the publication of the Carlsberg laboratories, and he sees no mention in this volume of the work by F. F. Blackman on gaseous exchanges, or of that by Cornevin on the degree of immunity of plants to vegetal poisons of autochthonous and alien origin.

Prof. Czapek is not of the opinion that the acceleration of oxidative processes by various metallic salts in association with colloids is likely to result in modification of existing notions of oxydases. The matter

is one, however, that requires extended quantitative and qualitative treatment. The supposition that an action is *entirely* due to a colloid, because the action ceases on separation of the colloid from the system, is an error commonly made by physiologists, due to the omission of taking into account phenomena of adsorption, and the complete alteration of conditions produced by the change.

There can be no doubt as to the value of this work in its completed form; it traverses practically the whole of physiology in its chemical aspect, so far as it is now possible to do so, and illustrates in an excellent manner the results that have been produced through application of chemical methods to physiological problems; it is the first extended treatise of the biochemistry of plants, and as such fills a void that was distinctly appreciable, and moreover fills it in a manner that places all vegetal physiologists under great obligation to its author.

F. ESCOMBE.

EXPERIMENTS WITH EXPLOSIVES.

New Methods of Testing Explosives. By C. E. Bichel. Translated and edited by Axel Larsen. Pp. 62. (London: Chas. Griffin and Co., Ltd.) Price 6*s.* net.

IN collecting together and translating the papers on the researches carried out in the laboratory of the Carbonite Explosives Company, Hamburg, the translator has given to English readers a valuable and interesting little volume. The title is perhaps a trifle misleading, but the whole scope of the work may be seen from the following quotation:—"(1) Why does a smaller quantity of one explosive than another cause ignition of fire-damp? (2) What are the incidental phenomena and the influences tending to promote such result? (3) In what manner do they co-operate in producing it?"

Appreciating the fact that it is desirable to work with quantities as nearly as possible approaching those employed in actual practice, special apparatus has been constructed, so that for the particular explosives dealt with we now have details obtained from experiment on a much larger scale than any hitherto adopted. In some cases charges of gunpowder as great as 1500 grams were exploded, and for the higher explosives often 300 grams. Even for the calorimetric determinations the bomb had a capacity of 30 litres, which was capable of taking a charge of 100 grams. There must always, however, be some risk with heavy charges of recording undue pressures, a point to which Noble has directed attention.

The actual pressures, gas volumes and composition of the products were determined from charges fired in Bichel's apparatus, the pressure being recorded by a piston indicator working on a drum. The record is really in excess of the true pressure, but it is stated that the indicated pressure is rarely more than two or three per cent. from the actual. The apparatus permits of variations of surface area for a definite charge, and so the cooling effect of the chamber may be eliminated. It appears that with this allowance the pressure at a given density of loading is proportional to that with higher densities. This, however, may not be strictly true with very high densities.

The actual temperature at the moment of explosion was calculated from the heat developed, the composition of the products and their specific heat, in the usual manner, but all such calculations are uncertain owing to doubt as to the specific heats of gases at these high temperatures, and the impossibility of taking into account dissociation. The possibility of fitting a thermo-junction into the Bichel apparatus might be worthy of consideration, for although the results cannot approach actual values, yet the relative temperatures recorded would probably serve as a useful check on those calculated. Macnab has already employed the thermo-junction for this purpose.

In connection with the safety of explosives for mining, undoubtedly the length of the flame, its duration and temperature are of the greatest importance. The two former were recorded photographically, a quartz lens being used. Some excellent plates of the flames are reproduced. A factor deduced from the ratio of the flame duration to the detonation time, termed the "after-flame ratio," is shown to have the greatest influence on the ignition of fire-damp, and a most instructive diagram shows the temperature developed, the length of flame, and the "after-flame ratio" for the explosives examined.

In considering the efficiency of an explosive the author makes a distinction between the dynamic action, due to the projectile-like action of the products on the surrounding surfaces, and the static energy, deduced in the usual manner from the volume occupied by the products at the calculated temperature of explosion. It certainly seems that a more rational classification is thus possible than when the two are considered together, and the results are claimed to be fairly in accordance with those obtained in actual practice.

The general bearing of the work on the question of safety is clearly dealt with, and four very complete tables give a mass of information relating to the explosives examined.

Sufficient has been said of the contents of the book to convince those interested in the subject of its great value. It deals almost exclusively with mining explosives, but it would certainly be of very great interest if the investigations could be extended to military explosives, for the author has such valuable apparatus at his disposal that experiments on this large scale could not fail to give much valuable information.

J. S. S. B.

CAUSALITY AND THE HUMAN WILL.

The New Science of Causation. By H. Croft Hiller. Pp. xiii+386. (London: The Walter Scott Publishing Company, Ltd., 1905.) Price 10*s.* net.

IF intrepidity were the prime essential of a philosopher, this work would be epoch-making, and its author would be a thinker of the first rank. He claims to have formulated a case—to his mind, abso-

lutely impregnable—against the intellectual foundations of empirical science. So impregnable, in fact, to the author's mind that he can afford to detail in the preface, with inimitable *naïveté*, his many discouragements in the preparation of the work—the fact, for instance, that of eight Fellows of the Royal Society with whom he has communicated all have declined to read and criticise advance proof-sheets. Sir Oliver Lodge has even gently indicated that Mr. Hiller's previous works have not impressed him; the letter is printed in full as a kind of *imprimatur*.

Briefly stated, Mr. Hiller's main position is that causality resides solely in the human will, and not at all in matter, atoms, ions, ether, electricity, or any of the other entities with which modern science deals. What reality ordinary objects possess is not quite clear, but apparently the action which we ordinarily suppose them to effect really belongs to the human being using them. Thus "a knife is a fetish facilitating cutting," *i.e.* cutting could quite well be done by the unequipped human will, but human nature being weak finds it useful for ordinary purposes to rely on the God-determined illusion of knives and scissors. Food becomes unnecessary, or can readily be replaced by poisons. In fact, there is no poison or disease at all but thinking, or rather willing, makes it so, *i.e.* if the individual will, acting on its own initiative, has not endowed an object with such and such attributes, then the consensus of other human wills, acting through hypnotic suggestion, so endows it. In this way, we presume, Mr. Hiller would account for the occasional death of infants by accidental poisoning. Doctors not only cure diseases, but also create and propagate them.

Considerations of space forbid a statement of Mr. Hiller's doctrine of perception, with its singularly elegant terminology—top storey of mind, mnemonic storey, and the like. But a word of criticism must be added, even if it is foolhardy to rush in where eight Fellows of the Royal Society have declined to tread. So far as we can understand our author, he seems in too great a hurry to explain abnormal experiences. He revels in things that make our flesh creep, people whose staple diet is strychnine, "Katie King" apparitions, ghosts that have pulses and heart-beats. Now of course we should all like to build up absolutely exhaustive systems, but at present well-sifted evidence of the extraordinary is so difficult to procure, and the abnormal is so often exploited by charlatanism for private ends, that science, which is long and patient, will rather wait a little and concentrate itself upon the normal. Again, there is obviously a difference in the glory of fetishes; there is one fetish which facilitates cutting, and another which facilitates Marconigrams. Will Mr. Hiller seriously maintain that a consensus of even all existing human wills could interchange these at its pleasure? Why had we to wait until the twentieth century for radio-activity? Could a sufficiently strong will in the nineteenth have produced the same effects by means of shoe-blacking?

We gather from the preface that this attempt to prove the rest of the world insane is merely a provisional instalment of a greater work, to be entitled "Sic Transit Scientia"! So important an effort to overthrow the walls of the empirical Jericho must be carefully timed; we can only suggest as the most fitting date of publication the eve of the Greek Kalends.

IONS AND ORGANISMS.

Studies in General Physiology. By Jacques Loeb. 2 vols. Pp. xxix+782. (London: T. Fisher Unwin, 1905.) Price 31*s.* 6*d.* net.

THE two volumes of papers collected under this title form one of the most interesting and suggestive works that have been published on the subject. The bold idea, that by means of alterations in the composition of the solutions that bathe the tissues it is possible profoundly to affect not only metabolism and growth, but also such processes as fertilisation, has led to a series of experiments here recorded that are well worthy of careful study.

The material with which Prof. Loeb and his pupils have worked has been in the main organisms of such a size that the whole animal could be acted on by changes in the salts dissolved in the water in which the animal lived. Most of the experiments were made with either the embryos or eggs of marine animals belonging to the groups of Annelidæ, Echinoderms and their allies; some were on fish embryos, some on hydroids, and the earlier experiments, which seem to have furnished the author with the leading idea for these researches, frog's muscle. This idea, shortly summarised, is that the changes in the composition of the solutions are effective on account of the properties of the various ions added or subtracted, and that by varying these one can control the various biological processes. The control is supposed to be direct, and ions are even termed "toxic" or "antitoxic" according to their suggested action on any process—for example, Sodium ions are "toxic," because they prevent the development of fundulus ova, Calcium ions are "antitoxic" because they neutralise this action.

The experiments which have perhaps attracted most attention are those on artificial fertilisation. Addition of HCl to the water in which the eggs of starfish (Asterias) were suspended caused them to develop parthenogenetically; similarly Ca was efficacious for the eggs of Amphitrite, KCl for Chaetopterus, and either KCl, NaCl, or even evaporation of sea water for the eggs of Arbacia, an Echinoderm. As to the accuracy of the observed phenomena, most of Prof. Loeb's readers will accept the evidence here adduced; whether the results bear the importance attached to them is a more open question. The author himself points out that these eggs are naturally on the brink of parthenogenetic development; in fact, if left to themselves they usually begin to segment spontaneously, and the effect of the addition of the various ions is only to hasten a naturally occurring process. It perhaps asks too much, but one regrets that the experimental difficulties so far seem to have prevented any of the parthenogenetic animals from attaining adult life.

For the rest, one notices that Prof. Loeb derives his inspiration from internal sources, and that quotations from other authors and from the *Archiv f. allgemeinen Physiologie* occupy but a small place. What, however, is more natural, if an author has sufficient new and interesting material to draw upon, than to confine himself to his own observations? Enough has been said to convey our impression that the two volumes now under review well repay careful consideration, and that the facts recorded therein mark an important advance in our knowledge of general physiology.

OUR BOOK SHELF.

Civil Engineering: A Text-book for a Short Course. By Lieut.-Col. G. J. Fiebeger, U.S. Army. Pp. xiii+573. (New York: Wiley and Sons; London: Chapman and Hall, Ltd.) Price 21*s.* net.

THIS text-book on civil engineering is especially intended for the use of cadets of the U.S. Military Academy, whose duties later are often those of a civil engineer. A short course on this subject is therefore provided, and this work is evidently based on the author's lectures at West Point. It is natural to expect that in these circumstances the treatment of the theory of structures will be that of the engineer rather than of the pure mathematician, and that it will be of the simplest possible character. It is therefore disappointing to find that this section is treated in an almost purely academic way involving much chasing of x, with little or no appeal to physical ideas. This is well illustrated by chapters iv. and v., mainly on the deflections of beams under various conditions of loading and fixing, a section of forty-nine pages, involving one hundred and ninety-three numbered equations, with little or no indication of their physical meaning. A semi-graphical treatment would have been far preferable for military cadets studying this subject with a view to practical applications, and this remark applies to other parts of the book; thus we should imagine that a student, after reading chapter iii., on the flexure and bending of beams, would have considerable difficulty in calculating the moment of resistance of a section such as a bridge rail, a perfectly easy problem by a semi-graphical method and one likely to require solution by an officer who "in an isolated station finds himself called upon to act as an engineer and constructor of buildings, roads, and bridges," with possibly a miscellaneous collection of materials.

In the purely descriptive part of the book the author is much happier, and a great deal of valuable information is contained in this section. Throughout the book the author is somewhat free with his terms; thus his use of the word molecule leads him to the statement that "the unit shearing stresses on the vertical and horizontal faces of the elementary molecule are equal," while other terms, such as "curve of mean fiber" and "spontaneous axis," might be amended with advantage. E. G. C.

Thunder and Lightning. By Camille Flammarion. Translated by Walter Mostyn. Pp. 281. (London: Chatto and Windus, 1905.) Price 6*s.* net.

THIS book contains no translator's preface, so one is apt to believe that it is a translation of M. Flammarion's "Les Phénomènes de la Foudre." A comparison of the two volumes shows that the titles of the chapters in each are identical, with the exception of two chapters of the French work which are merged into one in the translation. A closer examination leads one to conclude that the English edition is a very abridged form of the French, and the illustrations, which number fifty-four in the latter volume, only total nine in the translation. It is clear, therefore, that the two volumes are very different from each other, although one is supposed to be a "translation" of the other, since nothing is said to the contrary.

Apart from the above mentioned differences the English translation is well done, and will be found very interesting reading. The greater portion of the book is devoted to the effects of lightning flashes, and a large number of examples are described. Thus we have the effects on mankind, animals, trees, plants, metals, objects, and houses. Many instances are narrated of the vagaries of fireballs, and two chapters are devoted to atmospheric electricity and storm-clouds, and the flash and the sound.

Photography for the Press. By the editor of *The Photogram.* Second edition. Revised and very largely rewritten. (London: Dawbarn and Ward, Ltd., 1905.) Price 1*s.* net. Cloth, 2*s.* net.

THIS very complete and practical book contains hints to the photographer who wishes to make use of his pictures for press purposes. The editors acknowledge that this is a new departure in photographic literature, but the fact that the present edition is the second indicates that a want has been supplied. So large is the number of illustrated journals, books, &c., at the present time, and they are still on the increase and likely to become much more numerous, that time and possibly disappointments will be saved to the photographer if he becomes acquainted with many of the hints included in the present issue. In addition to some general remarks about the relation of the editor and publisher to the photographer, practical field and workshop methods are also discussed. Interesting and valuable information on the copyright union, copyright law, permits to photograph, &c., are next taken up, and lastly there are lists of agents for press photograms, publishers of picture post-cards, and the principal illustrated periodicals with all up-to-date information, such as class of print preferred, size of page, date and time to which originals are usually received for current issue, &c.

From the above it will be gathered that the book is intended to serve a very practical purpose, and the editors have produced a book that will be serviceable to many photographers.

How to Know the Starry Heavens. By Edward Irving. Pp. xvi+313. (London: T. Fisher Unwin, 1905.) Price 8*s.* 6*d.* net.

THIS volume is, avowedly, not so much a text-book for astronomical students as "an invitation to read text-books on the subject," but while it contains a large amount of real information, we fear that the matrix is so bulky that the reader to whom the book is intended to appeal will find great difficulty in discovering and assimilating the real facts. After discussing the apparent motions of the heavenly bodies and the rival theories concerning them, the reader is conveyed towards α Centauri in "The Chariot of Imagination" in order to gain some idea of the cosmological insignificance of the earth and to view more closely the sun and his system. Then the author attempts to instil a concrete idea of the dimensions of the visible universe. To this end he gives about twenty different illustrations, each one under a prominent subtitle such as "A Pile of Blood Discs" or "A Spider's Web," the whole occupying about fourteen pages. Succeeding chapters deal with other astronomical subjects in a popular manner and with more or less convincing illustrations.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Magnetic Storms and Auroræ.

THE observations of your correspondents Mr. Rowland A. Earp and Mr. R. Langton Cole, published in NATURE of November 23 (pp. 79–80), remind me that an aurora was also visible here (Cape Breton Island, Nova Scotia) on November 15 about 6 p.m., Halifax time.

Although only faintly visible on account of the twilight and the condition of the sky, the aurora was evidently of considerable intensity, throwing up streamers to the zenith.

I looked out again at 7 p.m., but could detect no signs of auroral activity then. Occasional watch was kept upon the northern sky during the rest of the night in hopes of a recurrence, but nothing further was seen.

ALEXANDER GRAHAM BELL.

Beinn Bhreagh, near Baddeck, Nova Scotia,
December 9.

WITH reference to a letter from Dr. Chree in NATURE of November 30 (p. 101) upon the magnetic storm of November 15, it may perhaps be of interest to mention that, according to a notice in the newspaper *Finmarken*, the aurora of that day in Vardö (lat. 70° 22′) was by far the most splendid seen there for many years. It is described as bright red all over, and, when most vivid, forming a belt over the whole sky from south-west to north-east. At last, about 11 p.m., the light gathered in the southern sky, making the impression of a huge fire some forty kilometres away.

Here in Christiania the sky was overcast, except a low horizontal stripe in the north-west, where the vivid greenish light was moving to and fro about 7 p.m.

H. GEDMUYDEN.

University Observatory, Christiania, December 16.

The Origin of Variations in Animals and Plants.

HAVING found much ambiguity in discussions of this subject, I have tried to formulate briefly the probable facts, as they appear to me.

(1) In the beginning, the germ-plasm was not separated from the somato-plasm, and hence it is assumed that "acquired characters" were inherited, and, we must suppose, still are by the protozoa. It seems probable, however, that the obvious effects of the environment were not permanent, but were recovered from in a few generations of cells or individuals, much as they are frequently recovered from in the metazoa during the life of a single individual. When they were too severe, they probably resulted in the death of the affected individuals or strains. In other words, there has been no regular "inheritance of acquired characters" among the protozoa any more than among the metazoa.

On the other hand, it seems reasonable to suppose that there were other more subtle effects, which in various slight ways *changed the molecular arrangements or composition of the plasm*, and effects so produced would be permanent until further changes of a similar nature took place.

The extraordinary permanence of type of protozoan and protophytan species, both in time and space, compels us to discard the idea that they are easily modified by external or any other conditions; while their marvellous diversity shows that they are *capable* of extraordinary modification. What causes the molecular changes (presumably nobody denies that they take place) is not apparent to us, partly because the phenomena must be very difficult (or impossible?) to demonstrate, and partly, perhaps, because they have been overlooked, all attention having been given to the obvious but less significant changes. Recent physical science has made us familiar with all sorts of subtle influences, and we do not know how any of them might affect the complex molecule of a living creature. Substances which hitherto behaved in a perfectly well known manner have given us surprises when we placed them in the presence of something new. So it may well be with the living molecule, and what we call "great changes in environment" may be nothing at all to it, compared with subtle influences which entirely escape our observation.

(2) In the first place, the molecular changes may have been good, bad, or indifferent (as tested by the prosperity of the creatures); but very soon selection would get in its work, and *those types of plasm which responded in certain ways to the more usual influences would be perpetuated*. Hence it would presently be found that variations were no longer indefinite, but were in certain prevalent directions—as they assuredly are.

(3) The fact that protoplasm shows such very definite tendencies low down in the scale of life (so that the hydrozoa, for example, seem wonderfully prophetic of subsequent evolution) might be used as an argument that life did not originate upon this earth, but came here with a long history already behind it.

(4) In the metazoa the matter is immensely complicated, because we have in each individual not one, but a large number of more or less independent variables. Nevertheless, I cannot doubt that the germinal elements are, as I have supposed in the protozoa, caused to vary (and nobody disputes the variation) by external influences; yet, from the selection and evolution of ages, their reactions have become so definite that we cannot see in them anything but "the nature of the beast."

(5) Since those germs would be selected (through their somata) which reacted in such a way as to produce the most favourable variations, it becomes easy to see why certain kinds of variation may be carried *beyond* the point of maximum utility. They are like habits, which may be formed in response to certain needs, but which afterwards become tyrannical, because the individual has acquired the property of responding to particular stimuli, and cannot stop when the stimuli become more numerous, or the effects accumulate unpleasantly.

(6) The fact that certain genera (*e.g.* Rubus, Aster, Agriolimax) are extremely prolific in species in some regions, and very little so in others, seems to show that some external influences have been at work in the former case and not in the latter. We may also direct attention to the effects of changed conditions in producing variability (*e.g.* in *Helix nemoralis*), and to the evolution of similar types in different regions.

(7) It may well be that the *appearance* of characters in the soma does not always or often follow in the generation after the germ is affected (*cf.* NATURE, February 16, p. 366).

T. D. A. COCKERELL.

Boulder, Colorado, U.S.A., December 1.

An Acoustical Method for the Demonstration of the Magnetism of Liquids.

ONE end of a glass tube, about 5 mm. internal diameter and 1 mm. thick, is heated in a blowpipe flame until the molten end contracts to a round nozzle, leaving a small aperture of less than half a millimetre at the middle. The other end of this tube is connected by a caoutchouc tubing to an air-bag of considerable capacity, which is pressed by a constant weight. The nozzle is wet with a drop of liquid. By opening the cock of the air-bag, the air escapes through the nozzle and produces a clear musical sound, the pitch of which depends upon the dimensions of the nozzle as well as the quantity and the nature of the liquid; it varies also with the pressure of the air inside and the inclination of the tube to the vertical.

If the nozzle, wet with a magnetic liquid, be brought close to the conical pole-piece of a strong Faraday's electromagnet and the field excited, the pitch of the sound changes more or less according as the magnetic susceptibility of the liquid and the gradient of the field is greater or less. With concentrated solution of ferric chloride or manganese chloride, a change amounting to an interval of a third is easily obtained.

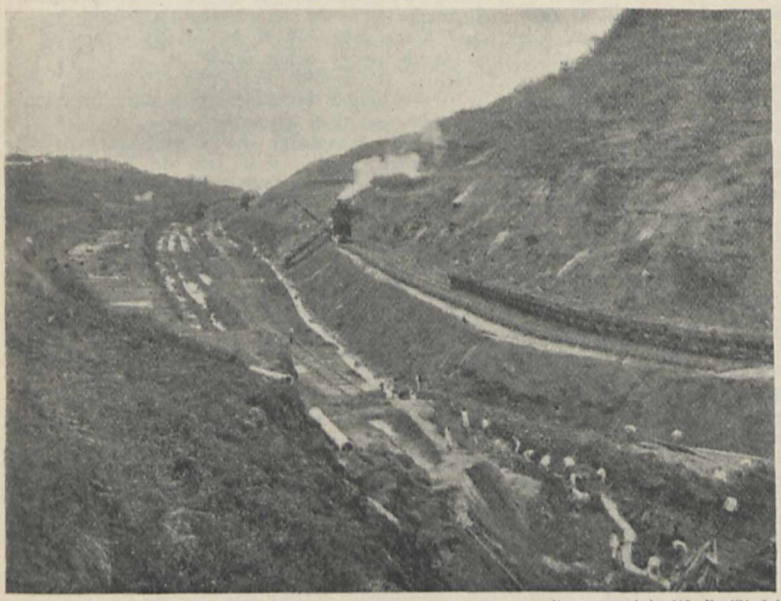
The details have been published in the *Proceedings of the Tokio Physico-mathematical Society*, vol. ii., No. 26.

T. TERADA.

Science College, Imperial University, Tokio, November 5.

THE PANAMA CANAL.

IN the issue of August 24 a review was given of General Abbot's book on "Problems of the Panama Canal," published this year; and in this book the construction of a canal with locks across the Isthmus of Panama, in preference to a sea-level canal, was strongly insisted upon. The October number, however, of the *National Geographic Magazine*, published in Washington, contains an article on "The Panama Canal," by Rear-Admiral Colby M. Chester, U.S.N., in which the advantages of a sea-level canal are quite as urgently advocated. Accordingly, the only points which have hitherto been definitely settled by the United States Government assuming the responsibility for the construction of the canal, are the final selection of the Panama route for the inter-oceanic canal and the consequent abandonment of the rival Nicaragua scheme, and the certainty of adequate funds being available for the completion of the Panama Canal, the want of capital having proved the most serious obstacle to the progress of the works when under the control of a private French company.

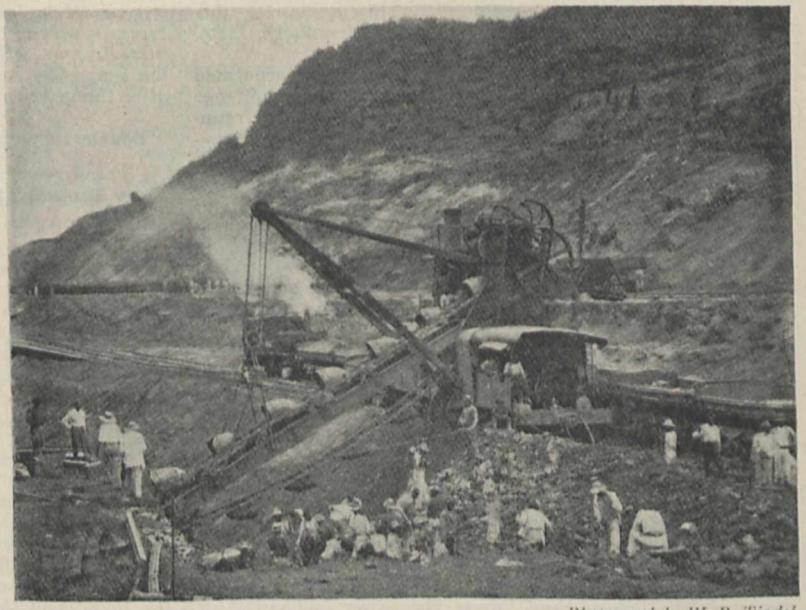


Photograph by W. P. Tisdel.

FIG. 1.—The Culebra Cut, Panama Canal, looking North.

There are undoubtedly several difficulties connected with this enterprise which have still to be overcome, such as scarcity of labour and unsanitary conditions in a proverbially unhealthy tropical climate; the vast amount of excavation that has to be accomplished in cutting through the high central ridge constituting the divide between the Atlantic and Pacific watersheds (Fig. 1), composed in the higher portions of treacherous strata exposed to an exceptionally heavy rainfall; and the control of the great torrential floods of the river Chagres cutting in several places across the line adopted for the canal, which follows the valley of the river along the Atlantic slope. These impediments, however, in course of time, by the help of ample funds, the progress of sanitary science, the great improvements effected in excavating and dredging plant (Fig. 2), and the increased experience gained in the construction of reservoir dams, should not prove insurmountable. In reality, the question which at the present time demands a definite and early decision is whether the canal is to be constructed with a summit-level a considerable height above sea-level, to be reached by means of locks on each slope, or is to be excavated down to a sufficient depth to form a sea-level canal with only a regulating lock, 4½ miles from the Pacific coast to Panama, to prevent the tidal rise in the Pacific Ocean of 21⅛ feet at springs creating injurious currents into and out of the canal.

When the Panama Canal scheme was started at Paris in 1879, M. de Lesseps insisted that it should be constructed at sea-level, like the Suez Canal; and the works were commenced in 1881 on that basis, relying upon the eventual success of the earlier work, without adequate preliminary investigations, and without due consideration of the differences in the conditions of the two sites. In 1887 the unexpectedly large cost and slow progress of the works led the canal company to diminish considerably the amount of excavation by the introduction of locks, thereby effecting a large reduction in the ultimate expenditure, and in the time required for the completion of the canal, as can be readily appreciated by a reference to the longitudinal section of the canal with locks (Fig. 3).



Photograph by W. P. Tisdel.

FIG. 2.—A Steam Shovel at work in the Culebra Cut, Panama Canal.

This is the principle upon which work on the canal since that time has been conducted, with modifications from time to time in the proposed summit-level; it was followed, after the failure of the old company in 1888, by the new company constituted in 1894, so far as their limited funds permitted; it was approved by the various French Commissions which reported on the canal; and it was adopted by the International Isthmian Canal Commission of 1899–1901, which submitted to Congress the design shown by the accompanying longitudinal section and plan. This design consists of a summit-level 21½ miles long, with its water-level 82 to 90 feet above mean sea-level, reached from the sea-level portion of the canal on the Atlantic side, 16 4-5 miles long, by two adjoining locks at Bohio, and from the sea-level section on the Pacific side, about 8½ miles long, by a lock at Miraflores arresting the tide and raising the water-level of the

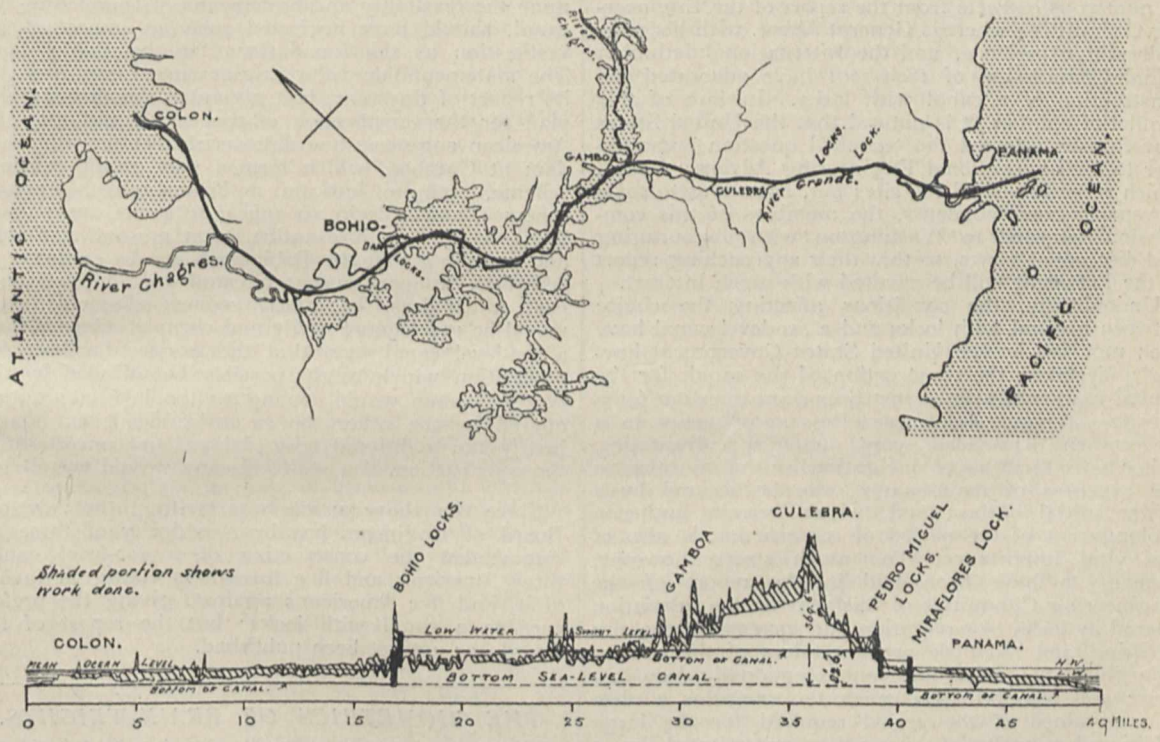


FIG. 3.—Panama Canal. Scheme with Locks. Commission of 1899–1901. Plan, Scale 1/600,000. Longitudinal Section, Horizontal Scale 1/600,000, Vertical Scale 1/6,000.

canal 30 feet above mean sea-level in a reach only 1½ miles long, and two adjoining locks at the end of this reach connecting it with the summit-level (Fig. 3). For thirteen miles of the summit-level on the Atlantic side of the deep Culebra cutting, the canal would pass through a lake formed in the Chagres valley by a dam near Bohio, as shown on the plan, which would materially accelerate navigation along this part. In an article on "Progress of the Panama Canal," following the one by Admiral Chester, to which the plan and section here reproduced are appended, it is stated that this design with locks is the only one "on which the Canal Commission has as yet any authority to spend money."

The canal problem entered upon a new phase this year by the presentation last February of a report to the United States Isthmian Canal Commission by its Engineering Committee, which Admiral Chester terms "the first definite engineering plans for the construction of the Panama Canal," in which a sea-level canal is recommended, thereby abandoning the proposals of all the engineers who had previously studied the question since 1888, and reverting to the original scheme of M. de Lesseps. This project consists of a canal with a bottom-width of 150 feet, a minimum depth of water of 35 feet, and twin tidal locks at Miraflores having an available length of 1000 feet and a width of 100 feet; and it is estimated that this canal could be completed in ten or twelve years at a cost of 230,500,000 dollars, the Chagres River being controlled by a dam at Gamboa, forming a lake from which the surplus waters would be discharged by a tunnel through the dividing ridge into another river-basin. The committee further urges that if a canal with locks should nevertheless be preferred, its summit-level should in no circumstances have its water-level more than 60 feet above mean sea-level, and estimates that such a canal would cost 178,013,406 dollars, and a canal with only a 30-feet summit-level 194,213,406 dollars. The committee considered that a sea-level canal, which is free from the restriction imposed by locks on the volume of traffic and size of ships passing through them, and could easily be enlarged and deepened to accommodate an increased traffic and larger vessels, would be well worth the additional cost, and that in view of the great progress achieved in the rate of excavation, the period required for its construction would be moderate; and the opinion was expressed that though a canal with locks could be made which might subsequently be transformed into a sea-level canal, such a modification could only be effected at great inconvenience to navigation, and at an excessive cost. A scheme proposed by Mr. Bunau-Varilla with this latter object in view is described in the article on "Progress of

the Panama Canal," in which four locks on each slope would lead to a summit-level 130 feet above sea-level; and so by greatly reducing the excavation required in the Culebra cutting, the designer considers that the canal could be completed in four and a half years; and it is proposed that a very wide earthen dam should be formed at Bohio with materials dredged in excavating the canal, and conveyed through pipes to the site, thereby creating Lake Bohio, as shown on the plan. Another lake would be formed by a dam at Gamboa, outside the line of the canal; and this canal with locks is to be transformed into a sea-level canal, when required, entirely by dredging without impeding navigation, the dredgers being worked electrically by means of the water-power from the lake, the basin of which is to serve as a depositing ground for the dredged materials.

Admiral Chester, as an old naval officer, is naturally in favour of a sea-level canal, and supports his view by numerous extracts from the report of the Engineering Committee; whereas General Abbot, with his wide hydraulic experience, and the International Isthmian Canal Commission of 1899–1901 have advocated the construction of a canal with locks. In face of this conflict of opinion, it is natural that the United States Government referred the technical question last summer to an International Engineering Advisory Board, which recently visited the site; but, according to some newspaper correspondents, the members of this commission returned to Washington with discouraging and discordant views, so that their approaching report to the President will be awaited with much interest.

Undoubtedly, the conditions affecting the choice between a canal with locks and a sea-level canal have been modified by the United States Government having undertaken the construction of the canal, for the capital cost, which is a most important question for a private company, is of much less consequence to a Government, provided very material advantages, either as to facilities of navigation or a diminution in the expenses of maintenance, can be secured by a larger initial outlay; and, within certain limits, a prolongation of the period of construction is also of less vital importance. Too much stress, however, appears to have been laid in the report of the Engineering Committee of this year on the restriction offered by locks to navigation and increase in the size of ships, and too little account taken of the cost of enlarging a canal through an exceptionally deep cutting; and also probably much too sanguine a view is entertained of the period required for the large additional quantity of excavation necessitated by a sea-level canal, especially considering the uncertainties as to the supply of labour.

The only restrictions to navigation caused by a canal with locks are the time occupied in passing through them, and the possibility of vessels being built larger than they could accommodate; but the loss of time can be considerably reduced by suitable arrangements for filling and emptying the locks, their capacity for traffic can be readily increased by duplicating them when required, and their dimensions would naturally be made at the outset, like the tidal locks at Miraflores, adequate for any probable increase in the size of the vessels. Moreover, in the design shown on the plan, a great portion, if not the whole, of the time expended in locking would be recouped by the increased speed attained by vessels in traversing the thirteen miles of lake navigation. The advantage of facility of enlargement claimed for a sea-level canal really more rightly belongs to a canal with locks, provided the locks are constructed with due foresight of future requirements; for whereas the portions of the canal from the Atlantic to Bohio, and from the Pacific to Miraflores, with a total length of 25⅛ miles, are the same in both schemes, owing to the excavation already accomplished, as shown by shading on the longitudinal section, about 11 miles of the lake portion in the canal with locks are considerably lower than required for giving 35 feet draught of water; whilst the remaining 10½ miles of the summit-level of the canal with locks could be enlarged and deepened by 82 feet less depth of excavation throughout than would be necessary for the sea-level canal (Fig. 3).

The only serious objection that has been raised against the design shown in the illustrations is that the proposed dam near Bohio would have to be carried down 42 feet lower to reach a foundation of rock than was anticipated; but it seems almost incredible that the commissions appointed during the period that the New Panama Company had control of the works, the special mission of which it was to determine the feasibility and best means of completing the canal, should have neglected such an important investigation as the foundations for the Bohio dam. The statements that the Engineering Committee, in its report of this year, had presented the first definite plan for the construction of the canal, and that the American engineers had discovered a better site for a dam at Gamboa, which formed part of the original scheme, seem to indicate a bias against previous schemes, and a desire to appear to strike out a novel line. So far as information is at present available, and assuming that the Bohio dam can be executed as designed, it appears that a canal with locks would cost much less, be much sooner completed, and would be much more easily and cheaply enlarged than a sea-level canal, and that the greater facilities for navigation which might possibly be afforded by the larger scheme would, owing to the lake navigation offered by the other, be so insignificant as not to justify the additional cost, delays, and uncertainties the construction of a sea-level canal would entail.

Since the above article was written, the Advisory Board of Engineers has by a majority of three recommended the construction of a sea-level canal, three American and five foreigners voting in favour of it, and five Americans against, giving the preference to a canal with locks; but the report of the Board has not yet been published.

THE BIOMETRICS OF BRAIN-WEIGHTS.

"We are not endeavouring to discredit anthropology, but to furnish such branches of it as anthropometry and craniology with new tools—a little sharp-edged to the uninitiated who handle them incautiously—but which will raise anthropometry and craniology in the future into the category of the more exact sciences" (Karl Pearson, *Biometrika*, vol. iii., p. 153, 1904).

"There is a mathematical science of statistics which must be learnt, and papers dealing numerically with anthropometric and craniometric data which do not now apply this theory are simply outside the field of science" (*Biometrika*, vol. iii., p. 397, 1904).

IT is not a raid, but a victorious invasion, that Prof. Karl Pearson and his school have made into the realms of anthropology, with the result that all that part of it which deals with men in the mass becomes an annex of the mathematician. The invasion occurred at a most opportune time; great collections of data which had been accumulated by the anthropologist threatened to bury him, for he had neither the method nor the appliances for welding them into a composite whole. Especially was this the case with the endless measurements of brain-weights obtained most laboriously by the anatomist and pathologist; they urgently required an application of the "mathematical science of statistics." Hence the series of articles which occupy the greater part of a number of

Biometrika[1] published a few months ago are particularly welcome; they lay a foundation for an exact knowledge of this subject.

For a hundred years and more anatomists have sought to establish a formula by which the mental ability of any individual could be predicted from an examination of the head or brain. The problem was found to be beset with difficulties and extremely complex. How was mental ability to be standardised and measured? Is the ability shown by any individual a fair and full manifestation of his endowment, or may it be presumed that much is latent and potential? Are all the nerve structures within the cranial cavity equally concerned in the manifestation of a simple mental process, or is the organ of the mind confined to a part or parts of the brain? At an early date it was discovered that the size of the mammalian brain depended to a considerable extent on the size of the body; age and sex, too, were found to influence its weight. The weight of the brain was found to vary widely from individual to individual without any evident relationship to mental ability, so that most scientific men came to share the opinion of the unscientific, that neither the shape nor the size of the head, the volume or weight of the brain, could provide any but the most uncertain indication of mental status. Those who sought a key in the arrangement and complexity of the convolutions have not been more successful. Yet the belief that there is a close relationship between the relative size of the brain and degree of intelligence cannot be abandoned, for it is founded on a study of comparative anatomy. Amongst primates, for instance, it is found that those members which most nearly approach man in size and complexity of brain also most closely resemble him in their mental processes. It is probable, as suggested by Prof. Ray Lankester (NATURE, p. 624, April 26, 1900), that the increase in brain-weight is correlated with the substitution of voluntary or conscious for reflex, instinctive or automatic mental processes, or, in other words, the increase of brain-weight which is seen in the highest primates is the substratum of that mental quality which he has named "educability"; there is also the widespread belief that eminent men have relatively large heads. An examination of the heads of sixty distinguished men led Dr. Beddoe to the conclusion that "Intellectual distinction is generally the concomitant of largeness of brain, though there are numerous exceptions" (*Journ. of the Anthropological Institute*, p. 277, 1904). The method by which Dr. Beddoe sought to establish a correlationship between intelligence and skull capacity is regarded by Lewenz and Pearson as "quite fallacious. To begin with he selects a formula—by guesswork—which is theoretically incorrect" (*Biometrika*, p. 392, vol. iii., 1904). To sum up, anthropologists have not been able to establish, by the methods commonly in use, that there is any direct connection between the size of brain and special manifestations of human intelligence.

Turning now to the biometricians, their conclusions have the advantage of being founded on extensive collections of data, and reached by methods which are mathematically sound. In the number of *Biometrika* cited at the commencement of this article, Dr. Raymond Pearl gives the results of a biometrical analysis of 2100 adult male and 1034 adult female brain-weights, belonging to five races, Swedish, Bavarian, Hessian, Bohemian, and English. Although the matter was only a side-issue in his investigation, he sums up his conclusion as to the correlationship between brain-weight and intelligence thus:—"There is no evidence that brain-weight is sensibly correlated with intellectual ability. The limits of this correlation have been shown to be not closer than 0 and ±0·6." Here are the conclusions of other biometricians:—"There is no marked correlation between skull capacity and intellectual power" (Dr. Alice Lee). "We find the correlation sensible but so small that it is impossible to base any prediction from the size of the head as to general intelligence" (Lee, Lewenz, and Pearson, quoted from *Biometrika*, p. 392, vol. iii., 1904). There are certain circumstances, too, which must be taken into account. From about the age of twenty onwards the weight of the brain gradually decreases, a diminution which is not, as a rule, accompanied by a decrease of intelligence. Nor does the mean brain-weight of a race correspond to the mean intelligence of that race. Of the five races investigated by biometricians, the English have the smallest mean brain-weight. The mean of the adult Englishman is 27 grams less than the Bavarian mean, 57 grams less than the Hessian mean, 65 grams less than the Swedish mean, and 120 grams less than the Bohemian mean. "The order of racial average brain-weight is very far from the order of average racial intelligence. Nor is the order bettered if we allow in any manner for stature" (Blakeman). On the data at present available, one must come to the conclusion, apparently anomalous, that a big brain, so far as the manifestation of intelligence is concerned, has very little if any advantage over a small brain. The explanation of that anomaly lies with the experimental physiologist and psychologist. Meanwhile it is well to remember that under the title of brain-weight is grouped a complex of organs which are diverse in structure and in function.

If there is so little correspondence between brain-weight and brain-function the apparent preponderance of the man's over the woman's brain in weight and size loses much of its significance. It is now possible, thanks to the labours of the biometricians, to speak with a degree of accuracy and assurance as to the extent of that preponderance. The sexual difference in mean brain-weight is least among the English; the preponderance of the male in England is 100 grams (Pearson, from combined data) or 103 grams (Blakeman, from Gladstone's data); in Hesse 132 grams, in Bavaria 142 grams, in Bohemia 144 grams, in Sweden 147 grams, and in France 181 grams. In round numbers, the male preponderance is from 8 per cent. to 13 per cent. Amongst gorillas the male preponderance is 17 per cent., amongst orangs 13 per cent., amongst chimpanzees 6 per cent., and amongst gibbons 8 per cent., so that the human sexual differentiation is approximately an average amount for a higher primate. How far is the male preponderance due to greater body size? The conclusions reached by biometricians are the following:—"Differences in stature and age account for less than one-third of the observed sex-difference in brain-weight" (Raymond Pearl). "On the whole, as far as present evidence goes, we can safely conclude that there is no sensible *relative* difference in the brain-weights of man and woman, the absolute differences observed are quite compatible with the differences which result from the relative sizes of the two sexes. . . . While our results thus apparently contradict those of Pearl on p. 51 of this Journal (*Biometrika*, vol. iv., 1905) the contradiction is only on the surface, for we have been able to use a far more complete system of physical measurements" (Blakeman, Lee, and Pearson). Yet if the writer has rightly grasped the

[1] *Biometrika*, vol. iv., parts i., ii., June, 1905, (1) "Variation and Correlation in Brain-weight," by Dr. Raymond Pearl (with twenty-three diagrams in the text); (2) "A Study of the Relations of the Brain to the Size of the Head," by Dr. Reginald J. Gladstone (with plates ii., iii., and five figures in the text); (3) "On the Biometric Constants of English Brain-weights," by Mr. J. Blakeman, assisted by Miss Alice Lee and Prof. Karl Pearson, F.R.S. (with six figures in the text).

methods used, the difference between the results is due to the fact that in his calculations Pearl took into consideration merely age and stature, while the second group of workers added a third, namely, the diametrical product—a quantity which roughly represents the size of the head. To the writer, who is a professed anatomist but not an expert mathematician, it seems that one must infer from these results that nearly two-thirds of the preponderance of the male brain is correlated with the greater size of the male head, while less than one-third is correlated with the greater size of the male body, using stature as a criterion of size. Clearly, if the writer's interpretation is correct, the cause of the relatively greater weight of the male brain is still to seek, for it will be readily granted that a greater brain must be correlated with a greater size of skull. The writer is prepared to believe that the relatively greater weight of the male brain is not only correlated with, but actually dependent on, the physically greater development of the male body, for amongst the various genera of anthropoids the sexual difference in brain-weight corresponds very closely to the sexual differentiation in body size.

To what extent, then, is the weight or size of the brain influenced by the bulk of the body as measured by stature or weight? Broca *was of opinion* that each addition of 10 cm. to the stature was accompanied by an addition of 5 grams to the weight of the brain; Marshall estimated the amount at 2·4 grams.[1] "In the Swedish males, an increase of 10 cm. in stature connotes an increase in brain-weight of 28·59 grams" (Raymond Pearl); the corresponding amount in English males is estimated by Blakeman at 38·69 grams. Dr. Pearl states that the addition of 16·5 kilos. to the body-weight has the same connotation as the addition of 10 cm. to stature. In biometrical terms, the regression is linear. Such is the conclusion which must be drawn from the human data at present available; but one may legitimately infer from the limited data provided by comparative anatomists[2] that it will ultimately be found that equal additions to the bulk of the body are attended, not by equal increments to the brain-weight, but that each successive addition to the body-weight is attended by a relatively smaller increase in the brain-weight. Manouvrier found that in passing from small to medium-sized dogs the addition of each kilogram to the body-weight was attended by the addition of 2·5 grams to the brain-weight; the increment in passing from medium-sized to large dogs 1·7 grams, and from large to very large dogs 0·7 gram. Marshall concluded from Boyd's data that a somewhat similar relationship exists between the body- and brain-weight in man. Gladstone has arranged measurements made on the heads of 363 Englishmen, belonging to all classes, in four groups, according to stature, and has given the mean diametrical product for each group. The diametrical product, as Mr. Blakeman demonstrates, gives only an approximate indication of the weight of the brain; but, allowing for that, it is still remarkable that the addition to the diametrical product steadily decreases as one passes from the lower to the higher stature groups. There is also direct evidence in favour of this opinion. Levi has demonstrated that the only cells in the body which show a marked correlation in size with the bulk of the animal are the ganglion nerve cells; but the relationship is such that we must infer that every further increment to the body-weight is attended by a diminished addition to the size of the nerve cells. If the cerebral nerve mass is regarded as the governing system of the body, then one would not expect that each addition to the body-weight would be attended by the same increment to the brain-weight any more than every subsequent million added to the population of a country requires an equal addition to its administrative service.

That there is a diminution in brain-weight in old age has been accepted as a truth for many years, but until now the rate of the diminution, the periods of life at which it occurs, and its exact amount have been undetermined. Pearl found that "after the age 15–20 there is a steady though very gradual diminution in the weight of the brain with advancing age. . . . In the Swedish males, an increase of ten years in age connotes a decrease of 19·39 grams in the brain-weight." In English males, from the data provided by Gladstone, Blakeman found that the brain lost 21·97 grams each decade. Not only does the brain decrease in weight, but the head shrinks in all its diameters—at least in our English "general hospital population." The head shrinks more in height than in length or breadth; the writer has observed that the skull of the cat and the gibbon shrinks in its vertical diameter as the animal becomes aged.

The brain reaches its maximum weight at a remarkably early period. Boyd, Vierordt, Marchand, Ziehen, and Gladstone found that the heaviest brain-weights occur between the ages of fifteen and twenty, but their conclusions rest on a narrow and uncertain basis; there is a remarkable dearth of observation on the weight of the human brain between the fifteenth and twenty-fifth years. During that period the body is increasing in size; Powys found that the maximum stature occurred early in the twenty-eighth year (*Biometrika*, vol. i.); since there is a correlationship between brain- and body-weight, there ought, therefore, to be an increase in the size of the brain so long as the body continues to grow. Clearly Blakeman and his collaborators, when they exclude all subjects under the age of twenty-four, are inclined to believe that the brain reaches its prime at a later period than the material at their disposal showed. They conclude that, so far as the weight of the body organs is concerned, there is apparently not a *period*, but only an *instant* of prime. Not more surprising is the result that the brain shrinkage is gradual; one would have expected a more rapid decrease after the ages at which Huxley proposed man should be pole-axed and Osler suggested the application of chloroform.

Much of the labour of the Pearsonian school was undertaken with the view of obtaining a method by which the size or weight of brain could be calculated with a sufficient degree of accuracy in the living subject. With that end in view, they have worked out on the data provided by Gladstone the correlationship of brain-weight with eight physical characters of the body, and found that the circumference of the head and the *diametrical product* (obtained by multiplying the length, breadth, and height diameters of the head) were those which were most closely correlated with brain-weight. Their prediction formulæ (multiple regression equations) are founded on the diametrical product and circumference, with deductions or additions for stature and age. These formulæ are applied to the head of Jeremy Bentham, to a skull reputed to be Dante's, and to "one of ourselves, P." The reputed Dante is found to have a probable brain-weight which is 80 to 90 grams below the mean of the English "general hospital population" (1328 grams); Bentham, a brain which was only a few

[1] See Keith, "The Growth of Brain in Man and Monkeys" (*Journ. Anat. and Physio.*, vol. xxix., p. 288. 1895).

[2] Eugen Dubois, "Ueber die Abhängigkeit des Hirngewichtes von der Körpergrösse bei den Säugethieren" (*Archiv f. Anthrop.*, Bd. xxv., 1899; *see also* Keith, *loc. cit.*).

grams above the English mean; while "P's brain-weight is essentially mediocre." By the use of these formulæ the brain-weight can be predicted in the living with a probable error of 50 grams. "Nothing better can probably be achieved by introducing further external characters, or by considering regression as curved instead of plane."

Looking widely at the labours of the biometricians on human brain-weights, they appear to the writer, who views them as an anatomist rather than a mathematician, to have accomplished three things:—They have fixed accurately the mean brain-weights for five subraces of Europeans, and shown that mean brain-weight is a racial character; they have estimated by a definite standard the degree to which the brain varies in size and weight according to the individual, the sex, and the race; they have worked out the extent to which various features of the head and body are correlated with the weight of brain, and expressed them in definite and permanent terms. They have laid a sound foundation for future statistical work on this subject, and yet, even at the risk of appearing ungracious, it is the writer's opinion that the full explanation of the relationship which exists between intelligence, brain-weight, and other characters is more likely to be discovered by those who investigate the individual than by those who study the mass.

THE HEAD-HUNTERS OF BORNEO.[1]

WITHOUT making any pretence to being scientific, this plain and unvarnished, but eminently readable, narrative of a lady's experiences among the natives of some of the more remote

FIG. 1.—Head-hunters at Kaningau. From "Everyday Life among the Head-hunters."

districts of the interior of Borneo contains a large amount of interesting information with regard to the customs and mode of life of both Dyaks and the less well known Muruts. Mrs. Cator, it appears, accompanied her husband on his official trips into the interior of that wonderful island, and during these underwent experiences and faced difficulties such as few ladies

FIG. 2.—Head-hunting Chief and his wife with the bamboo water-cans they always use. From "Everyday Life among the Head-hunters."

would care to repeat, and which afford incontestable testimony as to her pluck and resolution. Among these experiences it will suffice to refer to the account of her sleeping with her husband in a large shed in company with a long row of savage head-hunters who had never before beheld a white woman, or, for that matter, a white man.

It is, indeed, the portion dealing with the Muruts, or head-hunters, of the interior that forms by far the most interesting section of Mrs. Cator's volume, and the one which will appeal most strongly to ethnologists. The Muruts, according to the author, are a dark race compared to other races of the interior, and have certain customs peculiar to themselves, the preparation of a specially deadly form of the celebrated upas poison being one of their attributes. Although the Dyaks, except where under strict European control, are enthusiastic head-hunters, they preserve only the scalp and hair of their victims, scalp after scalp being added to their krisses with great pride. The Muruts, on the other hand, carry off and preserve the whole head as a proof of their prowess, their houses being frequently decorated with these ghastly trophies, which the author saw on more than one occasion suspended above her sleeping-place. "But there is nothing revolting in their head-hunting," writes Mrs. Cator; "they fight fairly. It is their chance of winning renown and showing what they are made of. The only low part of it is that a woman's head, owing to her longer hair, is prized even higher than that of a man; but the whole thing is a thrilling game to them, full of excitement and danger. There is nothing unfair in their warfare; both sides are doing the same, and man after man wins his spurs in feats of pluck and daring."

Despite the truculent character of their head-hunting

[1] "Everyday Life among the Head-hunters; and other Experiences from East to West." By Dorothy Cator. Pp. xiv+212; illustrated. (London: Longmans, Green and Co., 1905.) Price 5s. net.

forays, the Muruts, when not thus engaged, struck the author as being exceedingly gentle and extraordinarily peaceful in their home life, so much so, indeed, that during the whole of her sojourn among them not a single "family jar" was witnessed. Although, like most Malays (in the wider sense of that term), the Muruts are somewhat indolent in their nature, yet they collect considerable quantities of camphor, and grow such agricultural and garden produce as is required for all their wants, inclusive of material for clothes, while they are accomplished hunters and fishermen.

We have directed special attention to the account of the Muruts, as being the most interesting in the volume; but all the chapters, including those relating to the west coast of Africa, are well worthy of perusal, and the book may be heartily commended to all our readers. R. L.

REPORT OF THE GEOLOGICAL SURVEY.[1]

WE are glad to welcome the annual report of the director of the Geological Survey upon the work carried on by his staff and himself during the year 1904. It gives not only an account of the areas surveyed and the maps issued, but affords an insight into the new methods of research rendered possible and necessary by the advance of scientific knowledge. It is clear that, although maps showing the distribution of the rocks over the whole of the British Isles have been published, the survey is by no means complete, nor do we see that it can ever be considered as complete until all the resources of scientific investigation can be pronounced to be at an end. With regard to the maps themselves, much of the earlier work was put upon maps published as far back as 1819. Chemistry and physics, the appliances at the disposal of the petrologist, and the knowledge acquired by the palæontologist are all advancing with rapid strides, and we see on reading such a work as the annual report of the director of the Geological Survey how they are all brought to bear upon the economically important questions of identification of strata and utilisation of the resources buried in the earth.

One cannot often walk over the ground and detect at once what is of value in it, but a knowledge of the association of minerals may tell one that a certain vein may lead to a metalliferous lode. Hard earned experience and a well trained eye recognise a band of rock containing certain varieties of plants or animals. It may be itself of no use commercially, but yet be of the greatest value economically if it has been ascertained that it occurs in constant relation to some other stratum which is of value. Thus we find on p. 5 of the summary that "the search for coal beneath the Triassic rocks of the Midlands which has been going on for many years and is likely to continue, has brought into great prominence the importance of an accurate knowledge of the subdivisions of the upper unproductive measures"; and again, p. 11, "A seam of coking coal has been worked to the south-east of Alton. The depth and other details have not yet been ascertained, but fossils, similar to those got by Mr. Wedd in the brickpits at Bullbridge, Ambergate, have been obtained from the tip heap, and it is hoped that their distinctive character may enable this seam to be traced over a considerable area."

When we bear in mind that the discovery of one good seam of coal would probably repay the country the cost of maintaining the survey for many years, let us hope that it will be one of the last institutions affected by any policy of retrenchment.

The first object in founding the survey, and the school and museum then wisely connected with it, was the promotion of scientific research with a direct aim at economic and practical results, and every page of the report before us tells how admirably this object is being carried out. The surveyors note the occurrence and character of the various building materials met with—the stone, brick, and cement produced in various localities; they record where road metal may be procured and discuss the sources of water supply, a subject which, having regard to its importance, might well have a strong staff told off for its investigation.

We find in the text or in an appendix useful analyses of various rocks and minerals, descriptions of methods of dressing ores, and a discussion of the conditions which affect the search for coal-bearing strata which are covered over by immense deposits of later date and irregular occurrence.

It is clear that no one can tell beforehand what will be directly productive of economic results in such investigations as lie before the geologist, and the country demands the encouragement of scientific research and the pursuit of knowledge even where no one could foresee any practical results. We find that the survey does take cognisance of the physical geography of each district examined, its ancient lines of drainage, its raised beaches, and also investigates many difficult questions of chemical, thermal, and mechanical metamorphism, and the petrology and palæontology of rocks not obviously productive of anything of commercial value. The treatment of all these questions is arranged first of all geographically, so that anyone may turn to the description of his own district, and then stratigraphically, and the names of those who are responsible for the different statements are given in the margin. When we realise that this is the report of one year's work, we may look forward to the development of the summary into valuable treatises of great practical and scientific value.

[1] "Summary of Progress of the Geological Survey of the United Kingdom and Museum of Practical Geology for 1904." (London: Printed for H.M. Stationery Office by Wyman and Sons.) Price 1*s*.

NOTES.

AT a meeting of the Röntgen Society on Thursday next, January 4, Prof. F. Soddy will deliver the presidential address upon "The Present Position of Radio-activity."

THE death is announced of Mr. F. W. Burbidge, curator of the botanical gardens of Trinity College, Dublin. From a short obituary notice in Wednesday's *Times* we learn that Mr. Burbidge was born in Leicestershire in 1847, and, after studying horticulture at Chiswick and at Kew, afterwards combined a good deal of experience as a practical gardener with some adventurous journeys to Borneo and the East Indies as a collector of birds and orchids. He was appointed in 1879 to be the curator of the gardens at Lansdowne Road, Dublin, which belong to the Board of Trinity College, and are attached to the scientific side of the college. He filled his office with distinguished success, and made many important contributions to the literature of his subject, on which he was a recognised authority. He was a member of the Royal Dublin Society and of the Royal Horticultural Society, and in 1889 the University of Dublin conferred upon him the degree of Master of Arts, *honoris causa*. In addition to many articles in periodicals, Mr. Burbidge was the author of several books upon horticultural subjects.

AT a recent meeting of the Wellington Philosophical Society, as reported in the Wellington *Evening News* of November 4, an important discussion took place with re-

gard to the alleged sheep-killing habit of the New Zealand kea parrot. As is well known, this bird is commonly reported to cause the death of sheep—or to leave them in such a condition that death soon ensues—by pecking a hole in the side, and the alleged habit is accepted as a fact in ornithological and other natural history works. According, however, to investigations undertaken independently by a number of New Zealand gentlemen, the story is without a shadow of foundation. The observers included naturalists and estate agents, as well as others whose judgment must be regarded as equally trustworthy. The kea is a bird of unbounded curiosity, and it is suggested that the myth is probably due to this habit, some observer who had seen a kea inspecting the carcase of a defunct sheep or lamb having very likely jumped to the conclusion that the bird was the active cause of the animal's death. It is concluded that although the legend cannot be said to be completely disproved, yet there is not a scrap of evidence in its favour. Owing to its bad repute, the kea is in imminent danger of extermination.

THE ornithology of Oxfordshire, by Mr. Aplin, and notes on fishes taken at Yarmouth, by Mr. A. H. Patterson, are the subjects of the two articles in the December issue of the *Zoologist*. Mention of several birds new to the British list or of very rare occurrence in our islands is made in the notes column, the two new forms being the yellow-breasted bunting, from Norfolk, and the dusky thrush, from Nottinghamshire. A correspondent publishes a photograph of the skeleton of the fore-feet of a polydactyle cat, displaying duplication of the thumb on one side, and triplication on the other. Almost exactly similar conditions obtain in the feet of two such abnormal cats exhibited in the Natural History Museum.

THE December number of the *Naturalist* contains new regulations for the local protection of birds promulgated by the county councils of the North, East, and West Ridings of Yorkshire in response to a petition presented by the Naturalists' Union of the county. Among the more noticeable items are the extension of the close time for a previously scheduled list of species, the period now being from the last day of February to September 1; the total prohibition of the killing of a number of species mentioned in a second list for a period of five years; and total protection for a similar period of the eggs of a third list of species. Wild-bird shooting is entirely prohibited on Sundays, while two proclaimed areas are to be protected for a further five years. It is added that, in response to an appeal from the Union, the Bridlington Harbour Commissioners have prohibited the practice of firing at the birds on Bempton and Speeton Cliffs from passing pleasure-steamers.

Museum News (Brooklyn, New York), No. 5, opens with a dissertation on the proper mode of visiting museums, that is, in order to derive some benefit therefrom. Type descriptions of two exhibits are appended, one dealing with the eggs of the brant-goose and the other with the manati. The latter, we should say, is an excellent example of what a museum descriptive label ought *not* to be, for while manatis, dugongs, and rhytinas are all referred to, there is not a word to indicate how they are to be respectively distinguished. A novel practical exhibition—desirable or otherwise—has been added to the Children's Museum in Bedford. In a vessel of water are placed a few coins with an invitation to take one; but the coins remain, for in the water are a couple of charged wires, from which a severe electric shock is received.

FOUR papers on Cretaceous reptiles are included in the December number of the *American Journal of Science*. The two first of these are devoted to a couple of new representatives of horned dinosaurs (Ceratopsia) from the Laramie beds of Wyoming, discovered by the late Mr. J. B. Hatcher, for one of which the finder proposed the name *Triceratops brevicornis*, while to the second, which lacks the single nasal horn, Mr. R. S. Lull gives the new generic and specific title *Diceratops hatcheri*. A figure of a restored model of the head of the latter shows a creature strangely like a rhinoceros, save for the rudimentary condition of the nasal horn and the presence of a pair of horns above the eyes. We have now evidence of the existence of either one, two, or three functional horns in the Ceratopsia—features correlated by Mr. Lull with differences in the mode of attack of these giant reptiles. The one-horned form is supposed to have attacked in what the author describes as rhinoceros-fashion, *i.e.* with an upward thrust. Mr. Lull, however, appears to be unaware that neither of the Asiatic one-horned rhinoceroses uses its horn for fighting, but relies solely on its tusks! A mounted skeleton of a third species, *Triceratops prorsus*, in the U.S. National Museum, forms the subject of an illustrated paper by Mr. C. Schuchert. The fourth of the aforesaid series of reptilian papers is the first of a series by Mr. G. R. Wieland on Upper Cretaceous turtles, the forms dealt with in this instance being the small but thick-shelled Adocidæ (Adocus and Agomphus). The thickness of the shell may have been correlated with sublittoral habits as a protection against predatory dinosaurs.

THE four latest issues of the *Proceedings of the U.S. National Museum* comprise the description by Miss Richardson of a new species of the crustacean genus Livoneca from Panama (No. 1430); an account of the breeding habits and the segmentation of the eggs of the Florida pipe-fish (*Siphostoma floridae*), by Mr. E. W. Gudger (No. 1431); notes on exotic earwigs, with descriptions of new species, by Mr. J. A. G. Rehn (No. 1432); and a list of fishes collected at Shanghai and Hong Kong in 1882–3, by Messrs. Jordan and Scale (No. 1433), containing descriptions of half a dozen species regarded as new to science. In the above-mentioned paper on the Florida pipe-fish, Mr. Gudger gives a detailed summary of the history of our knowledge of the breeding habits of pipe-fishes and their kindred, and then discusses those of the species under consideration. In all these fishes the ripe eggs are transferred from the oviducts of the female to a special brooding-pouch on the under-side of the abdomen of the male. In the case of the Florida species, when the eggs are ready for transference the male and female fishes swim round and round one another for a time, and then intertwine their bodies in the form of a double letter S, with the heads of each turned outwards. In this position the eggs are transferred from the ovary of the female to the pouch of the male, where the two are in contact, about a dozen eggs being received in the pouch, where they are presumably fertilised. The male then performs a series of evolutions for the purpose of "shaking down" the eggs into the end of the pouch, on the completion of which the process of transference is resumed. The eggs, which soon become fixed to the pouch, are hatched in ten days. Full details, with illustrations, are given of the segmentation.

THE first appendix to the *Kew Bulletin* for 1906 has put in an early appearance; it contains a list of seeds of hardy herbaceous plants, and of trees and shrubs available for exchange with botanic gardens or regular correspondents of Kew.

IT has been recognised that in the case of the winter-greens, species of Pyrola, the seedlings possess some undiscovered peculiarity. In 1882 Kamienski described for the allied genus Monotropa the formation of a thread-like body out of which the flowering shoot arose. Ten years later Prof. J. Velenovsky announced that from the seed of Monesis, or *Pyrola uniflora*, there develops a primary body, a *procaulom*, from which the leafy shoot develops endogenously. Recently he has published an account of the seedlings of *Pyrola secunda* in the *Bulletin international de l'Académie des Sciences de Bohême*, October, in which he confirms his previous conjectures.

FARMERS in New Zealand are well instructed by the Department of Agriculture as to the wisdom of exterminating weeds, so that a discussion of the weed habit in plants by Dr. L. Cockayne, published in the *Canterbury Agricultural and Pastoral Association's Journal*, October, has its special interest. On cultivated lands the weeds are mostly aliens, but a number of indigenous weeds are spreading over pasture lands in different parts; they include *manuka* scrub, Leptospermum, cotton wood, *Cassinia leptophylla*, plantains, and species of Acacna that are distributed by means of their hooked burrs. The indigenous grass *Danthonia semiannularis* is a rare instance of an aggressive plant that possesses economic value.

As a point of some importance in connection with the stage at which grasses should be cut for fodder, Mr. H. H. Cousins gives in the *Jamaica Bulletin* (October) the results of chemical analyses made at different times. In the case of hay grass, *Sporobolus indicus*, cut after two weeks' growth, the albuminoids amounted to 10 per cent. of the dry weight, whereas after four weeks they barely reached 6 per cent.; a marked difference was also found in the hay of guinea grass, *Panicum maximum*, cut before flowering or during the fruiting stage. In the same number, in the course of a report on cocoa cultivation, Mr. Cradwick questions whether "fiddler" larvæ can attack undamaged and healthy trees; on this matter there appears to be a difference of opinion.

IN St. Lucia, according to the annual report for the year 1904–5 of the botanic and experiment stations, cacao planters are beginning to learn from the successful results shown on the experimental plots that a greatly improved yield can be obtained by systematic manuring and intense cultivation. Among products of secondary importance, the dwarf or Chinese banana, *Musa Cavendishii*, is receiving a trial, and the cultivation of vanilla is recommended. Mr. Hudson, the agricultural instructor, writing on the subject of supports for vanilla plants, selects the Liberian and a wild coffee plant, or the annatto, *Bixa orellana*, as the most suitable.

THE annual report for the year 1904–5 of the Board of Agriculture in Jamaica contains an account of numerous experimental plantations at Hope Experiment Station for testing varieties of bananas, plantains, cassava, tannias, citrus fruits, pineapples, and sweet potatoes. Of these crops cassava is of special importance, as it could be cultivated profitably on much land that is now lying waste, if central factories were erected for the purpose of manufacturing starch. In addition to the experimental plots, where sixty varieties of cane are on trial, the sugar industry is likely to benefit greatly by the central laboratory which is to be constructed. This will contain a room fitted up for analytical work, a fermentation laboratory, and an experimental distillery.

IT is becoming more and more evident that, even in minor earthquakes, the focus may be much more complex than the simple fissure or cavity accepted by earlier seismologists. Dr. C. Davison has familiarised us with twin foci in the small earthquakes of the British Isles, and now we have an account, by Dr. S. Arcidiacono, of Catania, in the *Bolletino della Societa Sismologica Italiana*, of the Sicilian earthquake of June 14, 1904, which, though nowhere more than a feeble shock, showed no less than four separate centres of maximum intensity.

A PAMPHLET issued by Pre. Raffaello Stiatteri, from the geodynamic observatory of Quarto Castello, near Florence, deals with the determination of the distance of the epicentre of an earthquake from the duration of the preliminary tremors. He finds from his own observations that, for epicentres not more than 2000 km. distant, the distance in kilometres is 5·63 times the duration of the tremors, expressed in seconds. Prof. Omori, working in Japan, deduced a similar formula, but his factor was 6·54 for the same limit of distance. This is attributed, with what seems sound reason, to a difference between the constitution of the earth's crust under central Europe and that under the sea east of Japan; but the possibility is indicated that the difference may be partly attributable to Prof. Omori's instruments being less adapted for picking up the earliest tremors than those built and used by the Abbé Stiatteri since 1902.

AT Detroit, Michigan, large deposits of salt underlie the limestone and sandstone at a depth of 1500 feet. Boreholes have been put down through which brine has been pumped; but up to a year ago all attempts to sink shafts to mine the salt have proved failures owing to the sulphur and gases encountered. On February 20 a new shaft was begun, and has been successfully carried to the salt. Illustrations given in the *Engineering and Mining Journal* show that a crib was employed made of 12 by 12-inch timbers bolted together and made absolutely water-tight. This was forced from the top downwards to the salt, Portland cement being used between the crib and the rock. Two powerful ventilating fans were used for driving out the gases; but even then men could only remain in the shaft for a very short time without losing consciousness.

THE last issue of the *Transactions of the Nova Scotian Institute of Science* (vol. xi., part i.), although somewhat belated in publication, records a year's useful scientific work. The most important paper contributed is that by Prof. J. E. Woodman on the geology of the Moose River gold district in Halifax county. It formed part of an investigation into the pre-Carboniferous history of the gold-bearing series. The gold occurs in sedimentary deposits and in veins. In the former it is held chiefly in slates, almost all being in the form of sulphides. In the quartz veins, however, a large proportion is free within the zone of oxidation, and a small amount below it. Detailed descriptions of the veins are given, and the paper is accompanied by eighteen admirable maps and illustrations. Other papers deal with sections and analyses of Nova Scotian coals, by Dr. E. Gilpin; contributions to the study of hydroxylamine and its salts, by Mr. W. H. Ross; and details of about forty fungi determined by Mr. R. R. Gates from the vicinity of Middleton, in Annapolis county.

THE Engineering Standards Committee has issued, in the form of a pamphlet of sixty pages, a report on progress of work from January, 1901, to July, 1905. Originally formed with the object of standardising steel sections, its scope has since been greatly enlarged. The subjects dealt

with up to the present time include:—rolled sections; railway and tramway rails; locomotives for Indian railways; pipe flanges; screw threads; pipe threads; limit-gauges; railway rolling-stock material; tire profiles; steel castings and forgings for marine work; Portland cement; cast-iron pipes; generators, motors, and transformers; prime-movers for electrical purposes; physical standards; telegraph and telephone material; electric cables; electric tramway materials; electric automobiles; and electric plant accessories. The report recounts the results of the labours of the committee, and includes a list of the members serving on the thirty-five sectional committees, as well as a list of the publications issued. It is impossible to exaggerate the value of the work done, and the thanks of all engineers are due to the five technical societies who supplied the funds to inaugurate a work of such national importance.

We learn from the November number of *Das Wetter* that the highest kite ascent on record was made at the aëronautical observatory at Lindenberg (Prussia) on November 25, an altitude of 21,100 feet being attained. In this ascent six kites were attached to each other, with a wire line of nearly sixteen thousand yards in length. The minimum temperature recorded was −13° F.; at starting the reading was 41°. The wind velocity at the surface of the earth was eighteen miles an hour, and at the maximum altitude it reached fifty-six miles an hour. Up to the time of this ascent the highest record by a kite was nearly 1100 feet lower, and was obtained by M. Teisserenc de Bort, from a Danish gun-boat, in the Baltic.

The Journal of the Meteorological Society of Japan for October contains an article (in French) on the rainfall of Chemulpo. The Japanese observatory was only established in April, 1904; the observations on which the present paper is based were made by the Corean customs officers during eleven years, 1893–1903. The mean annual rainfall is 38 inches, of which 7·7 inches fell in July; 53 per cent. of the total amount fell in three summer months. The average number of rain-days is 89. The heaviest rainfall during one hour was 0·85 inch, in August, 1901. The average duration of rainfall is about six hours, the longest falls being in springtime.

We have received from Dr. Hergesell, president of the International Aëronautical Committee, a summary of the ascents made during the four months May to August, in various countries, by kites and balloons. Only the heights reached are quoted—not the meteorological results, which will be published later on. The unmanned balloons obtained several records at heights exceeding 15,000 metres in each of the months:—in May, 18,490 metres, at Munich; in June, 20,620 metres, at Munich; in July, 20,000 metres, at Munich; on August 3, 25,800 metres, at Strassburg; on August 2, 15,230 metres, in the Atlantic, on the Prince of Monaco's yacht. In connection with the solar eclipse, ascents were made on the three days August 29–31. On the day of the eclipse, an altitude of 23,010 metres was reached at Munich. During the month of August several kite ascents were made in the North Sea by Mr. G. C. Simpson, under the auspices of the Royal Meteorological Society, and some valuable results were obtained, both as to temperature and humidity.

Lord Blythswood and Mr. H. S. Allen contribute to the *Philosophical Magazine* for October an interesting investigation of Dewar's method of producing high vacua by means of charcoal. It is shown that it is only necessary to increase the size of the charcoal receptacle in order to produce a high degree of exhaustion in a large discharge tube without the use of a pump. The method requires only moderate quantities of liquid air, and is particularly useful when it is desirable to avoid the presence of mercury vapour in the vacuum tube, as in the Geissler tubes used for spectroscopic analysis. A special investigation showed that the rate of absorption of the charcoal at any instant is proportional to the difference between the total amount of air absorbed and the amount which has been absorbed at the instant in question, that is, the rate is in a constant ratio to the quantity of air that will still be taken up by the charcoal. The constant is but little affected by alterations of the pressure under which absorption occurs.

The residual electromotive force of the carbon arc is the subject of a paper by Mr. G. G. Becknell in the *Physical Review* (vol. xxi., No. 3). The circuit used was so arranged that the dynamo and galvanometer could be alternately joined in series with the arc gap, and it was found that the so-called residual current could be observed for more than ten seconds after the interruption of the arc. From the experiments it is concluded that the current can be attributed neither to a thermoelectric effect in the arc nor to one external to it. A description is given of the means by which the residual electromotive force and current are measured as functions of the time, and from the curves shown it is seen that the fall of the current is much more precipitate than that of the E.M.F., showing that the resistance of the arc increases very rapidly. An explanation is suggested by considering that a stream of corpuscles is freely emitted by both incandescent terminals, but more abundantly from the positive, and that these diffuse across the arc gap until the carbons have so far cooled down that the rate of production of the negative ions by the positive carbon no longer exceeds the rate of their production by the negative carbon.

Messrs. F. Vieweg and Son have just issued a second revised and enlarged edition of Prof. F. Hofmeister's "Leitfaden für den praktisch-chemischen Unterricht der Mediziner," originally published in 1899.

Mr. J. A. Barth, Leipzig, has sent us a part of the second edition of the "Handbuch der Physik" edited by Prof. A. Winkelmann. This part is the first half of the fifth volume of the handbook, and in it Prof. F. Auerbach deals with electricity and magnetism. We await the remainder of the work before a review can be undertaken usefully.

Messrs. A. Gallenkamp and Co., Ltd., of Sun Street, Finsbury, E.C., are issuing a series of descriptive circulars giving full particulars of special arrangements of physical apparatus which they now make up for fundamental work in experimental science. The forms of apparatus have been carefully selected so that accurate results may be obtained by experiments with them.

New editions of parts of two valuable works on physics have lately been published by Messrs. F. Vieweg and Son, Brunswick. One is the first part of the first volume of the tenth enlarged and revised edition of Müller-Pouillet's "Lehrbuch der Physik und Meteorologie," edited by Prof. L. Pfaundler in cooperation with several other eminent German physicists and meteorologists. This part, by Prof. Pfaundler, contains the general introduction on the properties of matter, while the remainder is devoted to mechanics. The work will be completed in four volumes. The second part of the first volume of the seventh edition of Dr. J. Frick's "Physicalische Technik" has also been received. This work will be completed in two volumes, and notices of it and of the above mentioned treatise are best deferred until all the parts have come to hand.

OUR ASTRONOMICAL COLUMN.

COMET 1905c.—The results of numerous observations of comet 1905c (Giacobini) are published in No. 4058 of the *Astronomische Nachrichten*. Observing at Bamberg on December 10, Prof. Hartwig recorded the magnitude of this object as 10·0 and its diameter as 2′.

The following is taken from an ephemeris published by Herr E. Strömgren in No. 4060 of the *Astronomische Nachrichten*:—

1905–06	α (true) h. m. s.	δ (true) ° ′	log γ	log Δ	Brightness
Dec. 28	16 31 10	+ 5 54·2	9·8601	0·0312	5·16
,, 30	16 46 19	+ 3 45·6			
Jan. 1	17 2 3	+ 1 28·6	9·7908	0·0192	7·51
,, 3	17 18 25	− 0 56·7			
,, 5	17 35 24	− 3 29·7	9·7020	0·0148	11·54

Writing in the *Daily Graphic*, Mr. Denning states that the comet is rapidly becoming brighter, and should become visible to the naked eye early next month. On January 6 the comet will be about fourteen times as bright as when discovered.

ECLIPSE SPECTRA.—At the meeting of the Paris Academy of Sciences held on December 11, M. Salet submitted further, and more detailed, results of the discussion of the spectrograms obtained by him during the recent eclipse of the sun.

Two spectroscopes were employed, the one arranged for photographing the visual part of the spectrum, the other, made up of quartz and Iceland-spar optical parts, for photographing the ultra-violet end.

The slits of the spectroscopes were adjusted so that they bisected the solar images produced by two heliostats and collimators. On the one side of the sun the slit cut through an important group of prominences, and the resulting spectrum shows a number of lines, including those due to H, Ca, coronium, and He, and a line at λ 4025 to which no origin has as yet been assigned. On the other limb of the sun the spectrum shows only the lines due to coronium and the H and K (calcium) lines.

Of all the lines found, M. Salet believes that only the coronium line is truly coronal; this extends to about 4′ above the sun's limb, but does not descend to it, whilst the lines of other elements are strongest next to the limb, and are much shorter than the coronal line.

Twenty-two lines have been measured in the ultra-violet spectrum obtained—which extends to λ 308, and is very rich in bright lines—and of these eight are coincident with strong titanium lines in the ordinary solar spectrum (*Comptes rendus*, No. 24).

IONISATION OF THE ATMOSPHERE DURING TOTAL SOLAR ECLIPSE.—The results of the researches on the ionisation of the atmosphere during the eclipse of August 30, which were obtained by M. Charles Nordmann at Philippeville, are published in No. 23 (December 4) of the *Comptes rendus*.

Until about forty-five minutes after the first contact, the curve registered by the ionograph was of the regularly increasing type, such as was obtained on every day when the sky was clear. But at that time an unusual progressive recession took place, culminating in a sharply marked minimum forty minutes after totality, and this was followed by a gradual increase in the ionisation until, at about twenty minutes after the last contact, the curve assumed its normal height.

It thus appears from this research that the solar radiation is one of the factors on which the ionisation of the atmosphere depends, a result which accords with the hypotheses formulated by Lenard, Elster and Geitel.

The amount of the "lag" of the ionisation curve behind the related eclipse phenomena is also in accordance with theory.

MEASURES OF DOUBLE STARS.—The Greenwich results of micrometer measures of double stars during the year 1904 are published in No. 1, vol. lxvi., of the *Monthly Notices*. The observers were Messrs. Lewis, Furner, and Bowyer, and the observations were made with the 28-inch refractor (28 feet focal length), a power of 670 being generally employed. About 430 stars were measured, some of them on several nights, and the table given shows the coordinates (1900), the position angle, the distance, the magnitude, and the epoch of the observation of each pair.

GRAPHICAL METHOD FOR FINDING THE TIME OF MOONRISE.—In No. 10, vol. xiii., of *Popular Astronomy*, Fr. W. F. Rigge, S.J., of Creighton University (Nebraska), gives and explains a set of curves which may be used for finding the times of moonrise and moonset, on any future date, employing a graphical method which he believes has not been previously published. Three curves are necessary, one to determine the time of the moon's meridian passage, the second to give its hour-angle, and the third to obtain the correction to the rising and setting, due to the moon's motion in right ascension.

The correct result is easily obtained to within an accuracy of one minute, and the author states that he is able to compute the times of both rising and setting, for a whole month, in less than an hour.

NEW BUILDINGS OF THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE.

THE first section of the new buildings of the Glasgow and West of Scotland Technical College was formally opened on Thursday, December 21, by the Right Hon. John Sinclair, M.P., Secretary for Scotland. The opening ceremony took place in the examination hall, and was attended by a large and representative assembly. The chairman of the governors, Mr. Wm. Robertson Copland, presided, and in introducing Mr. Sinclair gave several details that are of general interest. The part of the building now completed and occupied represented about 70 per cent. of the whole scheme, and even in its uncompleted state was the largest of the kind in Great Britain. The floor area of the completed part extended to more than 187,000 square feet, or about four and one-third acres; the corridors in the building measured more than a mile in length; and there were 828 windows which required one acre and one-third of glass to fill them. The cost of the completed part was 211,743l., and was fully met by subscriptions already paid or by sums about to fall in. Although all the principal classes were now accommodated in the new buildings, there were still several industrial classes—for decoration, furniture design, printing, lithographing, and the like—that would have to be conducted in rooms outside the college. It was also pointed out that since the demand for new buildings became clamant about ten years ago, the increase in the number of day and evening students combined had been about 50 per cent.; last session, 1904–5, the day students numbered 530 and the evening students 4490.

The Secretary for Scotland said it was a very high privilege to be associated in any degree with so important a work. Nobody who knew anything of Glasgow or the west of Scotland and looked round that assembly, both on the platform and before him, could fail to recognise that an occasion which brought together the leading men in so many different spheres of activity was an occasion of special importance. That fact had been emphasised by the figures which the chairman had given them in connection with the technical college, and it must be a special gratification to the governors of the college that public appreciation of their work was so evident in the attendance of leading men that afternoon. As he understood it, this great institution was specially fortunate in carrying on an ancient tradition—a tradition dating from Prof. Anderson, a man who seemed to have been curiously modern in some of his ideas; and it must be a source of strength to that institution that it had so venerable a tradition to support and so wide a field of modern activity. No one would dispute henceforth, if they had been inclined to dispute it hitherto, that Glasgow and the west of Scotland generally, in the erection of that great building, in the size and selection of the staff, and in the growing attendance of the students, had shown a lively recognition of the value of such work as was done in that institution. As the chairman had pointed out, the plans of himself and the board of governors had not been fully attained; he

was sure it was the hope of all present that support would soon be forthcoming to enable the plans to be completed. There was another kind of support equally essential for the progress of the institution—the appreciation of its benefits by those who enjoyed them. They had a guarantee for that in the manner in which the management controlled and guided the affairs of the college; for the governors were assisted by committees having a practical knowledge of the different trades affected, committees consisting of employers and employed, of masters and men. He was sure all those who had the privilege of knowing anything, however little, of this institution would have confidence that in the future as in the past it would meet with that public recognition which it so truly deserved. In closing, he declared the new buildings open.

The memorial stone of the new buildings of the Glasgow and West of Scotland Technical College was laid on May 14, 1903, by His Majesty King Edward, and in NATURE, vol. lxviii., pp. 63, 64, a notice was given of the ceremony and also a sketch of the history of the college and an outline of the proposed scheme of new buildings. These will ultimately consist of five large wings, two parallel to George Street and three at right angles to them and parallel to Montrose Street; of these all except the principal portion of the front wing to George Street have been completed. The frontage to George Street will be 346 feet long, more than 100 feet in height, and will contain five floors and a semi-basement; the frontage to Montrose Street, 300 feet long, is shown in the annexed photograph. The plan of confining each department to one floor has been followed in nearly every case, and the internal arrangements generally are believed to be well adapted to efficient working. The figures given in vol. lxviii., p. 64, for the space allotted to each principal department represent very closely the dimensions in the completed part, and the equipment already provided has cost about 24,000*l.*; but additions to the buildings and equipment are urgently required, because, large though the premises are, they are inadequate for the accommodation of all the students of the college, and additional premises have still to be rented. G. A. G.

Photo. *Annan.*

FIG. 1.—Completed Part of the New Buildings of the Glasgow and West of Scotland Technical College.

RECENT STUDIES OF PERIODS IN METEOROLOGY.

IN *Symons's Meteorological Magazine* for November (No. 478, vol. xl.) Mr. A. P. Jenkin contributes an interesting note on periodicity of rainfall. Dealing with the Greenwich data commencing in 1843, he finds that there is a three-year period of rainfall, which, however, at times suffers reversal. Thus for a series of years we shall have two wet years followed by a dry one, and for a subsequent series two dry years followed by one wet one. Mr. Jenkin finds that this result can be obtained by transforming an actual period of 3·2 years into a period of 3·0 years, reversals taking place at the end of eight periods, and he compares the values thus obtained with the Greenwich rainfall figures. The result is interesting. As regards the origin of this three-year period, he says the "apparent period of three years with reversals is a real period of between *three and four years*, which is just what Sir Norman and Dr. Lockyer have observed in meteorological phenomena in India and other widely separated parts of the earth. . . ." Mr. Jenkin has apparently not seen the article which appeared in these columns in June last (vol. lxxii. p. 180), in which the relation between British pressure and rainfall changes and the Thames flow was discussed. The short-period British pressure variations (and consequently rainfall, since the latter is inverse to the pressure) were there shown to be intimately associated with the two main world-pressure types of those authors, as the following extract will show:—"During some years the British area is enveloped in the pressure system that extends over the large area in which India is about the centre, while for another series of years it is dominated by the antipodal pressure system of which South America is the middle portion."

"It is possible that it is this alternate reversion from one type to the other that prevents the 3·8-year change of the Indian and Cordoba curves from occurring in the British curves, and substitutes for it *an apparent shorter period of about three years*, which is very noticeable for some series of years in the British curves."

It will thus be seen that Mr. Jenkin has practically arrived independently at a similar conclusion. In the same note Mr. Jenkin deals with the Cape Town rainfall, which, as he says, shows the same result, though the number of periods in a series is six, and the time of reversal does not coincide with that of Greenwich.

In a series of important articles on the forms of cirrus-clouds, the last of which appeared in the *Meteorologische Zeitschrift* for October (vol. xxii., No. 10), Prof. Oslhoff, of Cologne, sums up his observations, extending over twenty years, as follows:—The ordinary origin of different cirrus forms are air currents of various kinds, which either cause existing cloud material to rend itself, or

carry water vapour which is condensed by penetrating colder air strata, and are immediately converted into ice-needles. These forms are also found under the more moderate clouds of the lower strata of the atmosphere, but in coarser form. Cirrus clouds gradually change their form in a period which coincides with that of the sun-spots, and consequently are caused by solar radiation. No kind of cirrus-cloud can be used with certainty as a weather sign. The influence of the sun at the time of sun-spot maximum is unmistakable in the case of clouds of moderate elevation.

In the *Journal and Proceedings of the Royal Society of New South Wales* for 1902 (vol. xxxvi. p. 42) Mr. H. I. Jensen contributed a paper on the possible relation between sun-spot minima and volcanic eruptions. This paper contained the results of an examination of the statistics, from 1780, relating to seismic disturbances and volcanic eruptions, and the conclusion at which the author arrived was that the frequency of both these phenomena varied inversely with the sun-spot curve, or, in other words, the fewer the sun-spots the greater the number of earthquakes and volcanic eruptions. In the volume of the same journal for the year 1904 (vol. xxxviii. p. 40) the author pursues the inquiry further, and, as he says, "I have succeeded in collecting numerous facts which throw further light on the question and strengthen my former conclusions." Later on in the paper the author refers to the letter published in the *Times* (May 19, 1902) by Sir Norman Lockyer, who stated that earthquakes and eruptions were most frequent at sun-spot minima and maxima. In this connection the author writes:—"My view was, and is, that these phenomena are at a maximum when sun-spots are at a minimum, although from my later researches it seems that at sun-spot maxima there sometimes is a violent and spasmodic outburst of volcanic violence."

Part ii. of this second communication deals with the connection between sun-spot and meteorological phenomena. The author here collects and summarises the conclusions of many workers, and adds a list of recent papers dealing with sun-spots, prominences, corona, earth-magnetism, auroræ, and meteorological data discussed in relation to solar changes. The communication concludes with a table of seismic and volcanic disturbances which occurred between April 1, 1902, and December 31, 1903.

In March last Dr. W. N. Shaw read a valuable paper before the Royal Statistical Society entitled "Seasons in the British Isles from 1878," which appeared in vol. lxviii., part ii., of the journal of that society. We have now received a reprint of that paper, and as it contains no less than 97 pages, including a discussion which occupies 6 pages, the reader may conclude that the subject has received very minute consideration. As director of the Meteorological Office, Dr. Shaw has at his command the most complete and homogeneous series of meteorological observations of these islands that exists, and in the present compilation he has so arranged the data that they are in a form at once suitable to anyone who may wish to study the relations of various phenomena with British weather. Like most other regions of the world, the British Isles are subject to wet years, dry years, cold years, and warm years, so that successive seasons differ very considerably from one another. Some of the meteorological statistics are therefore arranged to show at a glance the various characteristics of any year or season of the year. The contents of the reprint before us are not, however, restricted to the statistics of the meteorological data alone. We find that statistics relating to fog days in London, gales on the east coast, sea casualties, storm warnings, first flowering of forest trees, shrubs, herbs, beginning of corn harvest, yield of crops, deaths from various diseases, &c., are carefully correlated with the meteorological data according to each of the four seasons of the year. In the course of this compilation it was found that the relation between the autumn rainfall and the yield of wheat was very close. In fact, dealing with data from the year 1885, the yield was found to be above the average when the previous autumn rainfall was below the average, and *vice versâ* (1889 and 1903 excepted). Space does not permit us to deal with this important contribution at greater length, so we must refer those of our readers who are particularly interested in such statistics to the reprint itself.

In a pamphlet entitled "Ueber die wahrscheinlichkeit von periodischen und unperiodischen Schwankungen in dem atlantischen Strome und ihren Beziehungen zu meteorologischen und biologischen Phaenomenen," written by Otto Petterson, we have an interesting and valuable discussion on the correlation of hydrographic, biological, and meteorological data. This pamphlet is an extract from "Gesamtbericht, 1902–4," vol. iii., of the report and *procès-verbaux* of the international committee on the exploration of the sea (August, 1905), with the addition of an interesting introduction in which is briefly and clearly summed up the general hydrographic condition of those particular parts of the ocean referred to in the paper. In dealing with the annual variations it is first pointed out that there exists a temperature change of deep water (250 metres) at Motowskijfjord which reaches a maximum value in about November; this change is brought about by the Atlantic water. Reference is next made to the annual variations of the depths of the sea near the coasts of Holland and Sweden, and here the maximum is again in late autumn, namely, from October to December. It is shown that we are here in presence of a new phenomenon, namely, an annual pulsation of the sea, of which the whole ocean, from the tropics to the polar seas, takes part.

Our attention is then directed to the changes which take place from year to year, and it is shown how similar are the variations of the temperature of the sea on the Norwegian coast and the air temperature in the centre of Sweden. It is pointed out that the annual variation sometimes suffers perturbations, and is at times retarded or accelerated by a month or two; this is accompanied by important climatic and biological changes. The general impression gained is that the maxima and minima of water and air temperatures in the winter months are repeated in alternate years which indicate a two-year period in the hydrographic perturbations. The author then connects up these regular and irregular changes with the fisheries, and concludes that there exists a close connection between hydrographic, meteorological, and biological phenomena which should in future be taken into account.

ANTARCTIC EARTHQUAKES.

THE *Discovery* carried with her to the Antarctic regions one instrument which kept her, to a slight extent, in touch with the outer world. During the long intervals between the visits of the relief ship there was no word of sport or of the strife of party politics which fill so large a space in the daily papers, but from time to time the Milne seismograph told that somewhere there had been a great earthquake, and in some cases could even say approximately where it had taken place. Now, the records are serving another purpose, and the first instalment of their discussion has appeared as a "Preliminary Note on Observations made with a Horizontal Pendulum in the Antarctic Regions," read before the Royal Society by Prof. J. Milne, F.R.S.

In all, some 3000 feet of films, obtained by Mr. Louis Bernacchi, were brought back by the *Discovery*, and, as might be expected, their examination is still incomplete, in spite of the assistance which Prof. Milne acknowledges; yet one result stands out from the wealth of hints and suggestions which crowds the paper, in the discovery of a new submarine earthquake region lying to the south-west of New Zealand, from which came 73 out of the 136 distinct earthquakes recorded. This, however, does not end the matter, for it is found that not a few of these earthquakes were also recorded by the Milne pendulums in England, that is, near the antipodes of the origin, but not by similar instruments at a less distance. The explanation offered may best be illustrated by a simple experiment, which anyone can perform; take a circular tub containing water, dip your hand into the middle and raise it sharply, thus setting up a group of waves which travel outwards from the centre, becoming less and less conspicuous as the circles widen, until they may cease to be visible; presently, however, the reflected waves, con-

verging on the centre, will become visible, and, as the circles narrow, the waves get higher and more conspicuous until the centre is reached again. So the earthquake waves may become too small to be registered as they spread out from the origin, but again affect a seismograph as they converge towards its antipodes. Doubtless it is not only the earthquakes of the newly discovered region in which this takes place, but the present distribution of teleseismographs is not such as will allow of its being established in the case of other earthquake regions.

Apart from these results, which seem well established, there are many suggestions contained in the paper, two at least being important ones. The first of these concerns a peculiarity in the distribution of the stations at which earthquakes are recorded; for instance, those originating in the region to the south-west of New Zealand will be recorded along a band, of about 20° in width, starting in a north-westerly direction, but not at stations lying, nearer the origin, on one side or other of this band. So, too, earthquakes originating off the west coast of South America have been recorded in western Europe and, near their antipodes, in Siberia, but not at stations which we should expect them to affect were they propagated with equal intensity in an opposite direction.

The other suggestion, which may prove of great importance, concerns the diurnal east and west movement of the horizontal pendulum. This only affects pendula which point north and south and swing east and west; it is only noticeable on days when the sun shines, and has been attributed to the action of the sun's rays in heating or drying up the ground on either side of the recording station. These explanations have not proved satisfactory, and it is now suggested that the movement may be due to some other indirect effect of the sun, probably of an electrical nature. The Milne pendulum, with its silk fibre suspension and agate cup bearing, is practically insulated, and Prof. Milne finds that one of his pendula, after being electrically connected to earth, and therefore preserved at the same potential as the outer case and walls of the observatory, does not show the extensive movements it did prior to being earthed. This line of research is being carried forward with the cooperation of Dr. C. G. Knott, of Edinburgh, and we look forward to seeing some interesting results in due course.

We have indicated the most interesting of the results which have come from the seismographic records of the Antarctic Expedition; want of space forbids us to detail the many other suggestions and possibilities set forth by Prof. Milne, but what has been noticed is enough to show the good use that has been made of the record which, taken by itself, has little value, and only becomes important when correlated with those of the thirty-eight other stations where the Milne type of instrument is now installed.

TECHNICAL EDUCATION FOR FISHERMEN.

ABOUT six years ago the Lancashire Sea Fisheries Committee instituted practical classes for the instruction of local fishermen in the natural history of the common marine edible animals. "Technical education" in the strict sense of the word was not the object aimed at. For some time previously the committee had experienced considerable difficulty in enforcing the restrictions on methods of fishing contained in their by-laws on account of the determined opposition of the fishermen, and the object of the classes was rather to remove this opposition by showing the *rationale* of the by-laws, and to create a common ground on which both officers and fishermen could meet. The committee had no funds which they could apply to this work, and the classes were only made possible by the cooperation of the Technical Instruction Committee of the Lancashire County Council, which made an annual grant of 250*l.* to be spent for this purpose.

Practically all this money is expended in providing "fisheries exhibitions" of the value of 5*l.* each. One or more of these is allotted to each fishing centre in the administrative county of Lancaster, and the men selected to attend are chosen in various ways. In some cases they are selected by the fishermen's associations, and in other cases they are chosen by the officers of the committee. The grant of 5*l.* is intended to recompense the fisherman exhibitioner for the loss of his labour during the time he attends the class, and to provide for his expenses during this period.

The first two experimental classes were held at the (then) University College of Liverpool, but subsequently the work was transferred to the Lancashire Fishery Station at Piel, in the Barrow Channel, where tanks and other apparatus for the study of living organisms are provided by the fisheries committee, and where living material can easily be landed by the committee's vessels. The men are brought to Piel and taken away again by the patrol steamer, and lodge in the neighbourhood of the station. Each class consists of fifteen men, the maximum number which can be taught at one time with advantage. Twenty two-hour lessons are given during each course.

The course of instruction was drawn up by Prof. Herdman and Mr. Johnstone, and great care was taken to arrange a logical sequence of lessons. The structure of a typical fish is the first lesson, and this is followed by an account of the life-history of a typical mollusc such as the mussel. A short demonstration of the main chemical and physical processes involved in the respiration of marine animals is then given, and the manner of feeding of two such divergent types as the fish and mussel is then considered, a discussion which naturally leads up to three or more lessons on the nature and occurrence of plankton and on the economic importance of the latter. The remaining lessons deal with the life-histories of other economic marine animals, the cockle and oyster among Mollusca, and the shrimp and crab among the Crustacea. The life-histories of various fishes, such as the flat-fish and skate, are also considered, and the development of the flounder is studied from the process of fertilisation up to the time when the embryo issues from the egg. Although lantern and other demonstrations are given, the instruction is in the main practical in character, each man being provided with a good microscope and a set of dissecting tools.

On the whole the results of the classes have been very satisfactory; the main object, that of bringing about a better understanding between the fishermen and the committee, has been attained, and though there is still considerable opposition on the part of the fishermen towards the by-laws, yet the relations are much less embittered than was formerly the case. Another result of considerable importance has been attained in that the shell-fish transplantation operations carried on at Morecambe (an account of which was given recently in NATURE, August 31, p. 430) have been traced directly to the stimulus afforded by the classes. This work was originated by the Morecambe fishermen themselves, and it was in this district that the fishery classes were most appreciated and supported.

J. J.

LIFE-HISTORY OF THE EMPEROR PENGUIN.[1]

THE emperor is the largest of all the penguins, and is limited strictly to the ice-covered regions of the Antarctic. The interest of its life-history lies chiefly in the fact that its breeding ground was first discovered during the recent expedition made by the *Discovery* into the Antarctic. Its young and its eggs were brought home for the first time when the *Discovery* returned to England in September, 1904.

In reviewing the life of this bird, the difficulties of investigating its breeding habits were explained as the result of certain peculiarities; for example, that of laying the eggs in the middle of the winter darkness; each hen laying a single large egg, which it incubates as it stands in an upright position on sea-ice, keeping the egg from contact with the actual ice by holding it on the *dorsum* of the foot, and allowing a heavily feathered fold of skin to fall over it from the abdomen, thus completely obscuring it from view, and keeping it closely appressed to the abdomen, warm enough to hatch out, probably in some seven weeks. In the coldest month of the whole year,

[1] Abstract of a paper delivered before the Royal Institution by Edward A. Wilson.

viz. August, the chicken is hatched out, and becomes the unwilling recipient of so much attention from its parents, and from such other adults as have no young of their own to attend to, that upwards of 77 per cent. die, and may be picked up frozen on the sea-ice, within the first month or two of their existence. This high death-rate is in a large measure the result of the quarrels of adult birds for possession of a chicken, all having an overpowering desire to brood over something. In many cases the desire leads to brooding over dead chicks until they are actually rotten.

Much was said of the trials that must be endured by the naturalist who wishes to see this bird in its breeding haunts. He must be ready to encounter the lowest temperatures hitherto recorded, under canvas, sleeping three in a bag for what warmth can be procured at 40°, 50°, and 60° below zero Fahrenheit, and for a fortnight or three weeks at a stretch. Much, also, was said of the various sledge expeditions undertaken, after its first discovery by Engineer-Lieutenant Skelton, R.N., for the purpose of fully investigating the emperor penguin rookery at Cape Crozier; of the discovery of the first egg on the sea-ice by Lance-Corporal Blissett, R.M.L.I., and of the exceptional circumstances which, in the following year, enabled the lecturer to bring back to the ship a series of some fourteen eggs and several dozen of the young.

Examples were shown at the close of the lecture, which was further illustrated by a series of lantern slides, made from photographs taken mainly by Mr. Skelton and from drawings by the lecturer of the various stages in growth of the emperor penguin, from infancy to old age.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN view of the approaching contest for the representation of the University of London in Parliament, Sir Michael Foster, K.C.B., and Sir Philip Magnus have placed their opinions before members of Convocation of the University.

SIR WILLIAM ANSON has accepted the position of president of the Association of Technical Institutions for next year in succession to Sir Philip Magnus. The annual meeting of the association will be held at the Fishmongers' Hall on January 26 and 27.

THE annual conversazione of the Royal College of Science and Royal School of Mines was held on December 20. All the departments of the college and school were open, and many interesting exhibits were shown in chemistry, physics, mechanics, metallurgy, mining, geology, botany, and zoology, including applied science. The metallurgy section comprised a working exhibition of Japanese smelting methods shown for the first time in Europe. Japanese casting was made during the evening. The programme also included a lecture by Prof. S. H. Cox on "Incidents of a Mining Career."

THE late Mr. John Feeney, by his will dated June 22, 1903, bequeathed sums amounting to 89,000*l.* towards various institutions and objects connected with Birmingham and district. These include 20,000*l.* to the University of Birmingham. This bequest is for the purpose of maintaining a professor, with suitable equipment, lecturing on some one or more scientific subjects directly connected with some one or more of the trades and industries carried on in or near Birmingham. All the bequests are given free of legacy duty, but payment cannot be claimed until the expiration of five years.

THE Board of Education has published the reports, for the year ending March 31, 1905, of fourteen colleges which participated during the year in the annual grant, amounting to 54,000*l.*, made by Parliament for "university colleges in Great Britain," and from the three colleges in Wales which receive a grant of 4000*l.* each. The reports have been compiled, so far as has been found conveniently possible, under the same headings as those adopted in previous years. The distinguishing characteristic of the reports is the elaborate balance sheet with which each is provided showing exactly the revenue available in the case of each college and what precisely is done with it.

A BLUE BOOK (Cd. 2782) has been published giving the statistics of public education in England and Wales for the years 1903–5. The volume of 442 pages is divided into three sections, dealing respectively with elementary schools, State-aided secondary schools, and technical institutions, schools of art and day art classes, evening schools, and similar forms of education. A technical institution within the meaning of the regulations of the Board of Education is an institution giving an organised course of instruction in day classes, including advanced instruction, and provided with a staff and equipment adequate for the purpose. Provision must be made for at least a two years' systematic course in science, or in science and art, either alone or in conjunction with subjects of general, commercial, manual, or technological instruction; and subject to certain temporary provisions, no student may be admitted to the course unless he has passed through, at least, a three years' course of instruction in a school recognised under the regulations of the Board for secondary schools, or unless he is more than sixteen years of age and is qualified from his general education to profit by a course of advanced instruction. These institutions, in fact, afford instruction adapted for the preparation of young men for employment in connection with the trades, manufactures, and commerce of the country. They also provide higher courses of specialised instruction in science in relation to particular industries, likely to be required by students who have already had a good training in pure science. The number of these institutions receiving grants was nineteen in 1903–4. The number of students who attended at all during the year was 2143, and a grant of 5683*l.* was paid on 1056 of these who attended a full course of instruction. In the same year there were 5579 recognised evening schools with 696,882 students in attendance, on whose work a grant of 304,962*l.* was paid.

AT the annual headmasters' conference held at the College of Preceptors, London, on December 21, the subject of the inspection of schools was dealt with very fully, and numerous resolutions were adopted. Dr. Gow, of Westminster, moved a resolution, subsequently carried *nem. con.*, that the conference desires to emphasise the principle that inspection should take into due consideration the aims and circumstances of the school inspected, and regard intellectual methods and results as of greater weight than material equipment and appliances. Dr. Gow is reported by the Press to have said "there is a general opinion on the part of the public, which is shared by many teachers of science, that great expenditure is necessary for effective scientific teaching, and that schools are invited to compete with one another in mere expenditure. This competition is bad for the schools, for the teachers, and for the boys." It may be contended, he continued, that the better the teacher the more apparatus he wants, but Dr. Gow admitted that his own experience is the contrary of this. "No contention can be more absurd," he concluded by saying, "than that science teaching differs from any other because the science teacher does not teach by authority; it is, as a fact, conducted quite as much on authority as classical teaching, or divinity, or any other subject. The experiments are merely illustrations." The headmaster of Westminster has apparently been unfortunate in his experience of science teaching. Every man of science agrees with him that for the effective teaching of the broad principles of science the simplest apparatus, if of the right kind, is sufficient. This competition among schools to provide the most luxurious laboratories and lavishly stocked lecture-rooms, if it exists, is at least a very modern growth, and should, as Dr. Gow maintains, be discouraged. But at the same time a sensibly designed science workshop with simple fittings and an adequate supply of ordinary apparatus is an absolute necessity for every efficient school. It is difficult to understand what Dr. Gow means when he maintains that science teaching is as much based on authority as the teaching of classics or divinity. There is a confusion of thought here. Reasonable science teaching, with which Dr. Gow seems unfamiliar, insists that the pupil shall believe only because experimental results leave no other alternative, and not because a teacher or a text-book makes a statement. If in any school experiments are used only as illustrations the methods of science

are not followed, and the work is not what men of science desire to encourage. It is satisfactory to know that at least in a large number of our secondary schools the science periods are made the means of inculcating habits of careful observation, persistent verification, and truthful reasoning.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—"On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*.—A Study in Relationship to the Causation of Malignant Disease." By Prof. B. **Moore**, Dr. Herbert E. **Roaf**, and E. **Whitley**. Communicated by Prof. W. A. Herdman, F.R.S.

The attention of the authors was attracted to the study of the effects of small variations in reaction upon the growth of cells from the biochemical point of view, as a result of the observation that in malignant disease no hydrochloric acid is in general secreted by the gastric glands, no matter where the malignant growth is situated, which pointed to an increased alkalinity of the plasma.

In the course of investigations upon the rate of growth of the cell, when microscopic examination was made of the cells in the fresh condition, the authors were struck by the marked irregularities in size and shape of the developing cells in alkaline media, illustrated by cells in fresh solution developing in sea-water, to which di-sodium phosphate has been added, and also by marked tendencies to nuclear proliferation.

This led secondarily to a cytological investigation of the cells when fixed and stained to show nuclear division, as a result of which the authors have found the irregular forms of mitosis described in the paper. These atypical divisions, which have been produced by variations in the medium similar to those which occur in the blood in cases of malignant disease, closely resemble the pathological divisions seen in the growths of malignant disease.

The results of the experiments and their relationship to the processes in malignant growths may be summarised as follows:—

(1) In nearly all cases of malignant disease the secretion of hydrochloric acid by the gastric glands is stopped or greatly reduced, and this effect is not due to local conditions in the stomach, since it occurs wherever the growth is situated, but is due to a change in the distribution of salts in the plasma whereby the alkalinity is increased or the concentration in hydrogen ions diminished.

(2) Addition of *small* amounts of alkalies or alkaline salts, such as di-sodium phosphate, to the medium in which cells are growing and dividing causes at first an increase in rate of growth and division, but as the amount is increased there appears a marked tendency to irregularity in size and shape of the resulting cells. Nuclear division becomes in advance of cytoplasmic division, so that the cells become multi-nucleated. As the alkali is further increased, both cell division and nuclear division are stopped.

(3) Accompanying the increased stimulus to nuclear division given by the dilute alkali, there are seen many of the atypical forms of mitosis described in malignant growths. The variations from the normal illustrated in the drawings are:—(1) multiple nuclei in the same cell in active division; (2) multipolar mitosis, occurring both in the single cell stage, and later in the development of the organism; (3) asymmetrical mitosis, leading to unequal distribution of chromosomes to the two daughter cells; (4) reduction in length of the chromosomes as the strength of alkali is increased until the chromosomes appear as rounded dots, and accompanying the reduction in length there is also a reduction in number to about one-half the normal; (5) in certain cases the chromatin becomes arranged in circles, each of which shows a number of thickenings. The circles are arranged in groups in the cell, and appear to represent a stage in the anaphase, the groups being placed at about the usual distance apart of the centrosomes, and traces of the achromatic fibres being occasionally visible.

"On certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics.—A Contribution to the Chemistry of Anæsthesia. (Second Communication.)" By Prof. B. **Moore** and Dr. Herbert E. **Roaf**. Communicated by Prof. C. S. Sherrington, F.R.S.

The experiments recorded in the present communication support the conclusion drawn in a previous paper by the authors that anæsthetics form unstable compounds or aggregates with the proteids of the tissue cells, and that anæsthesia is due to a paralysis of the chemical activities of the protoplasm as a result of the formation of such aggregations.

The comparative experiments with ethereal extracts demonstrate that the action is upon the cell proteids and not upon the lipöids.

The compounds or aggregations so formed are unstable, and remained formed only so long as the pressure of the anæsthetic in the blood is maintained.

The results of the experiments may be summarised as follows:—

(1) The solubility of all anæsthetics experimented with is higher in serum than in water.

(2) At a certain concentration, definite for each anæsthetic, there occur opalescence and commencing precipitation of proteid.

(3) At equal concentration of chloroform in water or saline on the one hand, and serum, hæmoglobin, or the tissues (brain, heart, muscle, and liver) on the other, the vapour-pressure is always higher in the former than in the latter.

(4) The curve connecting vapour-pressure and concentration is, in the case of water and saline, a straight line; while in the case of serum, hæmoglobin, and the tissue proteids it is a curve showing association, especially at the higher concentrations.

(5) Comparative determinations of vapour-pressure and concentration, in serum and brain tissue and in ethereal extracts of these equal in concentration of lipöid, show that the proteid of the tissue combines with the anæsthetic.

(6) Determinations of the effects of addition of chloroform upon the lowering of freezing point confirm the results obtained by the vapour-pressure and solubility determinations.

(7) Determinations of the changes in electrical conductivity caused by addition of chloroform indicate that accompanying the combination of the anæsthetic with the proteid there takes place a splitting off of electrolytes.

(8) When the lipöids, extracted from serum or tissues by ether, are made up into an emulsion with normal saline, many of the lipöids take the form of bi-concave discs.

(9) The lipöid emulsions are very permanent, but separate on the addition of anæsthetics or neutral salts, in similar fashion to colloidal solutions.

"A Note on the Effect of Acid, Alkali, and certain Indicators in Arresting or otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*." By E. **Whitley**. Communicated by Prof. W. A. Herdman, F.R.S.

(1) The amount of variation from the normal concentration of hydrogen and hydroxyl ions in sea-water which the eggs of Pleuronectes will tolerate is very small.

(2) A disturbance of the equilibrium towards the acid side is much more fatal than the opposite.

(3) A progressive development of resistance to an unfavourable action of the environment takes place in proportion to the age of the eggs.

(4) Phenolphthalein is deadly to the eggs of *Echinus esculentus*, but harmless to those of Pleuronectes, while dimethyl quickly kills the latter, and appears, if anything, to have a favourable influence upon the development of the former.

Anthropological Institute, December 5.—Prof. W. Gowland, president, in the chair.—A Dyak witch doctor's medicine chest: R. **Shelford**. The chest is cylindrical in shape and about a foot high, and contains various charms, including water-worn pebbles, a crystal, used for a kind of crystal gazing, and a few simples which have actual curative properties.—Ruins in Rhodesia: D. Randall

MacIver. Mr. MacIver visited sites at Inyanga, Niekerk, N'Natali, Umtali, Dhlo-Dhlo, Kami, and Zimbabwe, views of all of which were shown. At Inyanga there are countless "pit dwellings," consisting of a pit and passage and hut platforms. The elucidation of the mystery of their use is assisted by a study of the Niekerk ruins, which are the most remarkable in the country. The area of these ruins is not less than fifty square miles, and within this area it is almost impossible to walk more than ten yards without coming upon a wall. The general principle appears to be that each hill constitutes a separate unit complete with its own buildings and divided at the bottom from its neighbour by a boundary wall, which is the first of a series of concentric lines. These lines cannot have been for purposes of irrigation, but must have been entrenchments. They always cease at the crown of the hill, which is covered by a series of buildings, and it is this fact which shows the bearing of these walls in the problem of the pit dwellings. The buildings in the hill are of two types, one divided by successive stages from the pit dwelling and the other the pit dwelling itself. The forts at Niekerk are also generally of similar or derived form to those at Inyanga. Similarly, the more advanced type of buildings found at Umtali or elsewhere are all derivatives of the pit dwelling, and Great Zimbabwe itself falls into line, and was simply a royal kraal. In the whole country there seems to be a regular progression with regard to these buildings, the northern region being the most fortified, and the defensive scheme becoming less rigorous towards the south. As to the buildings of these forts and dwellings, all the implements found are of the type used by the natives of the present day, and as at Niekerk there is no evidence of modern squatting it seems fair to presume that similar implements found elsewhere are also not the results of squatting, but were left by the original builders. As to the date, Mr. MacIver cut sections in the ruins he visited, and at Dhlo-Dhlo he made a most significant and conclusive discovery. A trench was cut below the intact cement floor of a hut, and amongst other objects Mr. MacIver discovered fragments of Nankin china. Consequently, no stone was laid at Dhlo-Dhlo before the time when Nankin china was manufactured and imported from the East; experts fix this date as the sixteenth century A.D. This find conclusively fixes the date, for Dhlo-Dhlo and all the other remains exhibit similar characteristics of building, and it may be taken as proved that the ruins of Rhodesia are mediæval or post-mediæval, that they cannot be possibly placed earlier than the eleventh century (probably the very oldest building was not erected before the fourteenth century), and that they were built by a native African race not differing to any great degree from the modern natives.

Entomological Society, December 6.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—A series of varieties of the Mediterranean *Carabus morbillosus,* showing all intergradations from the ordinary *morbillosus,* and presenting a striking case of geographical variability: Dr. K. **Jordan.**—Specimens of *Ptinus pusillus,* Stwem., recently discovered in a corn factor's shop at Edmonton: H. St. J. **Donisthorpe.**—A hermaphrodite of the Proctotrupidæ, a sand-wasp without wings captured by Mr. Poole, and the ♂ *Apion semivittatum,* Gyll., taken many years ago by Mr. Walton near the Tivoli Gardens, Margate, together with a ♀ specimen of the same species discovered while sweeping long grass near the Chequers Inn, Deal, on September 26, 1904: A. J. **Chitty.**—A ♂ and ♀ example of the Dipteron *Helophilus transfugus,* L., taken from thistle-heads in the fen marshes at Edmonton last July, and a specimen of *Stenopteryx hirundinis,* a parasite on swallows and martins found on Box Hill, Surrey, in August: F. B. **Jennings.**—Specimens of *Odontopera bidentata* ab. *nigra,* the melanic form of which is rapidly increasing in the Wakefield district of south Yorkshire: G. T. **Porritt.**—Specimens of South African Pierine butterflies taken in the dry season this year, further illustrating the diverse forms, and with them, for comparison, specimens taken during the rains: Dr. F. A. **Dixey.**—A ♂ and ♀ specimen of *Ornithoptera chimaera,* Rothschild, and some remarkable species of Delias collected recently by Mr. A. S. Meek in the mountain region of British New Guinea: O. E. **Janson.**—Specimen of a Buprestid beetle, *Cyria imperialis,* Don., having, in addition to the normal fore-leg on the left side, two supplementary fore-legs originating from separate coxæ: Commander J. J. Walker, on behalf of Mr. A. M. **Lea.**—♂ and ♀ examples of *Tetropium crawshayi,* Sharp, bred by the Rev. G. A. Crawshay from eggs deposited in July last in the bark of larches at Leighton Buzzard: G. C. **Champion.**—Unique specimen of *Depressaria emeritella,* Stn., from an unknown locality, on which the species was added to the British list many years ago, and a specimen of *Cerostoma asperella,* L., discovered by Mrs. Hutchinson near Leominster on September 21, 1881, and only taken, as regards Britain, in Dorset (formerly), and Herefordshire very rarely: E. R. **Bankes.**—Series of *Tryphaena comes* bred through three generations, and brought together to test the relative proportions of melanic to non-melanic forms and the possible range of variations to be obtained from a single pair of parents: A. **Bacot.** The exhibitor announced that all the results of the second and third generations seemed to be capable of "Mendelian" explanation.—(1) Larvæ of *Collyris emarginatus,* Dej., from Borneo, observed with mouth-parts qualified to excavate burrows in wood. (2) Larvæ and pupæ of Mormolyce, together with a specimen of a fungus of Polyporus split open to show the lenticular chamber excavated by the larva, to which access was obtained by so small an orifice that it was surprising that the emerged beetle could squeeze through: R. **Shelford.**—*Papers.*—Some observations by Mr. A. H. Hamm, of the Hope department, Oxford University Museum, tending to confirm the opinion that *Pieris rapae* chooses for prolonged rest a surface on which it will be concealed: E. B. **Poulton.**—On the emergence of *Myrmeleon formicarius*: W. J. **Lucas.**—Descriptions of new species of African Halticinæ and Galerucinæ: M. **Jacoby.**—On the ichneumonidous group *Tryphonides schizodonti,* Holmgr., with descriptions of new species: C. **Morley.**

Linnean Society, December 7.—Prof. W. A. Herdman, F.R.S., president, in the chair.—On the ætiology of leprosy: Dr. J. **Hutchinson,** F.R.S. The author adduced much evidence from all parts of the world in support of the fish hypothesis of the cause of leprosy, more especially from South Africa, China, and Norway. In places where the disease is scattered and infrequent there might, he admitted, be some difficulty in tracing the association of cause and effect; but if regard be taken of those only in which excessive prevalence occurs, all hesitancy would disappear. He challenged anyone, not yet convinced, to name any place in the whole world in which the leprosy prevalence exceeded 50 per 10,000 which was not either a fishing-station or notorious for the consumption of bad fish. As instances of places where this enormous prevalence has been recorded, the following were mentioned:—Minicoy (Maldives), Kalagoan (Bengal coast), Fiji, and the Sandwich Islands. By way of affording a standard of comparison, it was added that the prevalence in Ceylon was only 2 per 10,000, and in India as a whole less than 6.

Faraday Society, December 12.—Mr. James Swinburne, vice-president, in the chair.—The physics of ore flotation: J. **Swinburne** and Dr. G. **Rudorf.** The flotation of ores to separate them from gangue is carried out by treating them with dilute acid, or acid sodium sulphate, at a temperature short of boiling water. Little bells of CO_2 attach themselves to the ore particles, but not to the gangue, and the ore particles are floated to the surface, where they are skimmed off. The questions are why the sulphides are selected, and why the temperature matters. The authors hold that it is a question of two opposing forces—adhesion between the solids and the liquid which varies with different solids and liquids, and surface tension of the liquid.—The concentration of metalliferous sulphides by flotation: Prof. A. K. **Huntington.** The paper also embodies the author's contribution to the discussion on the previous paper. Experiments are described which prove that the gas causing flotation is CO_2 derived from native carbonates of iron and manganese present in the ore, and not from calcite or from carbonates produced on the surface of the sulphides by weathering. Carbonates which are decomposed by dilute sulphuric acid in the cold do not

give rise to the formation of a scum. Experiments are also described showing that the gas escaping during flotation carries an electrical charge, leaving an opposite charge on the solution. The assumption of Messrs. Swinburne and Rudorf of the presence of an air-film on the surface of the sulphide particles is criticised, and it is shown that the particles are floated perfectly after precautions have been taken to remove any adherent film of gas by exhaustion with acid, washing with alcohol, treatment with air-free distilled water, and exhaustion with the pump.—The ions of pure water: Prof. J. **Walker.** In the discussion on Dr. Lowry's paper on an application to electrolytes of the hydrate theory of solution, Mr. Bousfield directed attention to an apparent discrepancy between the temperature coefficient of the mobility of hydrogen and hydroxide ions on the one hand, and the temperature coefficient of the conductivity of water on the other. The author points out that when the data obtained by Kohlrausch for pure water are employed, and when allowance is made for the temperature coefficient of ionisation, the discrepancy vanishes.

Geological Society, December 12.—Dr. J. E. Marr, F.R.S., president, in the chair.—The physical history of the great Pleistocene lake of Portugal: Prof. E. **Hull.** There is evidence that the general level of the lake-bed was once nearly that of the outer sea, and that the sea-waters gained occasional access to the lake during the earlier stage of its formation. The lake was eventually drained by the channel cut by the Tagus at the harbour of Lisbon, upon the elevation of the land to about its present level.—The geological structure of the Sgùrr of Eigg: Dr. A. **Harker.** The conclusions arrived at bring the rock of the Sgùrr of Eigg into relation with the other British Tertiary pitchstones, which are all intrusive.

MANCHESTER.

Literary and Philosophical Society, November 28.—Sir W. H. Bailey, president, in the chair.—Experiments on the variation of the electrical resistance of osmium with the temperature: H. **Morris-Airey.** The range over which the experiments were conducted extended from the temperature of liquid air up to dull red heat. The results show that the behaviour of osmium, like that of the ordinary metals, can be represented by a parabolic expression.

DUBLIN.

Royal Dublin Society, November 21.—Prof. W. F. Barrett, F.R.S., in the chair.—Energy of secondary radiation: Prof. J. A. **McClelland.** This paper is a continuation of previous papers in which the author studied the secondary radiation of β particles that is emitted by substances when acted upon by the β rays of radium. The relative intensity of the secondary radiation from a large number of elements for the same incident radiation has been previously measured, the results showing that the secondary radiation is always greater the greater the atomic weight. In the present paper the total energy of the secondary radiation from a lead plate is compared with the energy of the primary radiation that produces it, the plate being thick enough to prevent the transmission of any radiation; the ratio is found to be 0·62 for lead, and corresponding numbers are given for other elements, the numbers, of course, diminishing with decreasing atomic weight, the number for carbon being 0·19. From the known value of this ratio we can calculate theoretically what percentage of the energy absorbed by *any element of the plate* is set free again as secondary radiation; the percentage is as high as 94 for lead and 95 for uranium, with smaller values for lower atomic weights, the percentage for carbon being 53. The importance of this large transformation of the energy of the primary radiation into secondary radiation is shown by some examples. The relation between the coefficient of absorption of the β rays and the value it would have if there were no secondary radiation is calculated; for lead one coefficient is about four times the other. Again, when we determine the coefficient of absorption of a radiation by measuring the intensity after passing through successive layers of a substance, we should, on account of secondary effects, get values of the coefficient diminishing with increased thickness traversed, even if the radiation were perfectly homogeneous. For this reason the β rays from radium are not so heterogeneous as they appear to be from observations on absorption. The paper shows how to determine the true coefficient from such observations.—An improved form of entoptoscope for the detection and delineation of cataract, &c.: W. F. **Barrett,** F.R.S. The author exhibited this instrument, and fully described it with the aid of diagrams and lantern slides.

Royal Irish Academy, November 30.—Prof. R. Atkinson, president, in the chair.—Second report on Irish cave explorations: Dr. R. F. **Scharff,** chairman of the committee. Dr. Scharff gave a general survey of the investigation, and mentioned that the report embodied the results of the work carried on in the caves of co. Clare during the years 1903–4 under the direction of Mr. R. J. Ussher. The latter subsequently showed a series of lantern slides giving a narrative of the events. Prof. Cole described the geological features. The caves originated by the solvent action of water on the Carboniferous limestone, and may possibly be pre-Glacial. Mr. Westropp read the portion of the report dealing with the tools and ornaments found, which included chert scrapers, various bone implements, bronze pins, and a beautifully worked bronze buckle, as well as an ancient gold bracelet. Prof. A. F. Dixon dealt with the human remains, while Mr. Newton described the very numerous bird bones, which included those of the crane, now only an extremely rare irregular visitor to the British Isles. The mammalian and other vertebrate and invertebrate animal remains had been determined by Dr. Scharff, who exhibited specimens of the bones and teeth of Irish elk, reindeer, Arctic lemming, Arctic fox, bear, wolf, and Caffer cat, and those of domestic animals, &c., making remarks on their horizontal, vertical, &c., distribution in the caves.—On the former occurrence of the African wild cat (*Felis ocreata*, Gmel.) in Ireland: Dr. R. F. **Scharff.** Remains of the wild cat are abundant in the upper stratum of the Clare caves. Careful measurements show that this cat was not the wild cat of Europe (*Felis catus*), but the African cat (*F. ocreata*=*F. maniculata*), and that the English cave remains of cat are also mostly referable to the latter species.

EDINBURGH.

Royal Society, November 20.—Lord McLaren, vice-president, in the chair.—Some further results obtained with the spectroheliometer: Dr. J. **Halm.** This was a sequel to a previous communication already published in which the main object was to find how Carrington's law of solar rotation varied with the sun-spot cycle. The relative shift of certain solar spectrum lines taken from opposite limbs of the sun was determined by comparing their positions with the positions of neighbouring telluric lines. If, however, instead of the *difference* of the positions of a chosen solar line the *mean* be taken, the true position of the solar line referred to the neighbouring telluric line is obtained as it would be were the sun not subject to rotation. Now, according to Doppler's principle, the relative position of the solar and telluric lines so determined should be affected by (1) the annual motion of the earth as it recedes from and approaches to the sun; (2) the diurnal motion of the earth on its axis; and (3) the swing of the earth about the centre of gravity of the earth and moon during one complete lunation. The amounts of the displacements of the lines in the solar spectrum due to these three motions may be calculated. The monthly motion is too small to be detected with certainty, being of the same order as the errors of observation. The instrument was capable of detecting the others. By calculating the diurnal effect and subtracting it from the observed positions, Dr. Halm obtained a distinct annual periodicity in the measured positions of the chosen line, and the observed variation agreed within the errors of observation with the calculated effect. Similarly, subtraction of the calculated annual effect left the diurnal effect clearly marked

and agreeing also remarkably well with the calculated value. In the observations, however, which had extended over the last four years, there existed undoubted evidence of a shift which could not be explained in terms of any known motions. It would be interesting to see how this shift continued as the sun-spot cycle passed through its approaching maximum. The only suggestion which the author had to offer in explanation was the possible effect of a changing pressure in the sun in the neighbourhood of the material giving the line.—Observations on the normal temperature of the monkey and its diurnal variation, and on the effect of changes in the daily routine on this variation: Drs. Sutherland **Simpson** and J. J. **Galbraith.** The diurnal temperature variation in the monkey had considerable range, being about twice that of man in normal health. The temperature reached its maximum during the day and its minimum at night. When by artificial illumination and darkening of the room day and night were interchanged, and when at the same time the meals were altered appropriately, the temperature variation was found to change also, the maximum always coming during the time of activity. Starvation for three days quite did away with the rhythmic character of the variation.—Notes on the effect of electric oscillations (co-directional and transverse) on the magnetic properties of iron: J. **Russell.** The oscillations were obtained from an induction coil, and their general effect was greatly to increase the induction in moderate fields, and also to increase the hysteresis during a complete cycle. When the cycles were compared between the same limits of induction, the effect of the electric oscillations was to diminish the hysteresis.—Some electrical measurements on metals: Dr. C. E. **Fawsitt.** The aim of the experiments was to measure the electromotive position of two specimens of the same metal, one of which had been rapidly cooled and hardened and the other slowly cooled and annealed. The metals used were silver, gold, and platinum, and in all cases the hardened amorphous form was found to be electropositive to the annealed crystalline form when placed in dilute acid, the potential difference being about 0·013 volt.

New South Wales.

Linnean Society, September 27.—Mr. T. Steel, president, in the chair.—Notes from the Botanic Gardens, Sydney, No. 11: J. H. **Maiden** and E. **Betche.** In addition to several new species and varieties described, the following species are recorded as new for New South Wales:—*Capparis sarmentosa,* A. Cunn., from the Macpherson Range; *Casearia esculenta,* Roxb., from the same locality (the discovery of this species adds another order, Samydaceæ, to the flora of New South Wales); *Pultenaea mollis,* Lindl., from Gilgandra; *Erythroxylon australe,* F.v.M., from the Macpherson Range; *Strychnos psilosperma,* F.v.M., from the same locality; *Marsilea angustifolia,* R.Br., from Gilgunnia.—Notes on the native flora of New South Wales, part iv., the occurrence of *Casuarina stricta,* Ait., on the Narrabeen shales: R. H. **Cambage.** *Casuarina stricta* is one of the sheoaks found chiefly in the southern part of Australia, including Tasmania, and it is also common in the interior of New South Wales. The author recently found it growing on the Narrabeen shale formation at Newport. The shales dip southerly from Narrabeen, and pass under Port Jackson at a depth of nearly 1000 feet, but outcrop again at Otford and Stanwell Park, where *C. stricta* also reappears. The theory is advanced that in late or post-Tertiary time this species flourished on what is now regarded by geologists as the submerged continental shelf, but formerly was a continuation of the present land-surface, extending, perhaps, twenty miles easterly to the 100-fathom line. As the Narrabeen shales in the vicinity of Port Jackson also rise to the eastward, they would probably have formed the surface in places beyond the present shore-line, and it is suggested that *C. stricta* worked its way up from the south, partly along this old land-surface, but, owing to the subsidence, has all been destroyed with the exception of these isolated remnants at Newport, Otford, and Jervis Bay.—Census Muscorum Australiensium: a classified catalogue of the frondose mosses of Australia and Tasmania, collated from available publications and herbaria records: part ii.: Rev. W. W. **Watts** and T. **Whitelegge.** This second part of the census completes the mosses known as acrocarps. About 370 species are listed.

October 25.—Mr. T. Steel, president, in the chair.—The geology of the New Hebrides: D. **Mawson.** The following is a summary of the author's conclusions:—The chain of islands forming the New Hebrides group owes its existence primarily to the development during Miocene times of a fold-ridge apparently continuous with that passing around the north of New Guinea through Sumatra and on to the better known region of the Himalayas and southern Europe. In the New Hebrides the folding period was preceded by local shallow marine conditions and subdued volcanic activity. The folding force would appear to have been exerted from the direction of Fiji against the foreland of New Caledonian crystalline schists and gneisses; a single ridge probably resulted defining the western line of islands where extensive outcrops of Miocene strata are exposed—in Santo, Malekula, and possibly Efate.

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