THURSDAY, JANUARY 2, 1908.

## THE INHERITANCE OF "ACQUIRED" CHARACTERS.

*Sur la Transmissibilité de Charactères acquis.* By Eugenio Rignano. Pp. 320. (Paris: F. Alcan, 1906.) Price 5 francs.

A MAN of science to command general attention and interest must do two things; first, he must make interesting discoveries or profound generalisations; and, secondly, he must do these things at the right time. Darwin made his name because he fulfilled both these conditions. Mendel died an unknown man because he did not fulfil the second. He was forty years too soon. Supposing that Mendel's paper *had* been completely lost sight of, as it actually was for thirty-five years, and very nearly was altogether, his results must, sooner or later, have been obtained by somebody else, who would then have won the laurels which now belong to Mendel, not because he made a greater discovery than Mendel, but because he made it at a time when the state of biological thought was such that it could appreciate the significance of the discovery.

If it is possibly fatal to make discoveries too soon, it is certainly fatal to make them too late. It is therefore with a certain sense of weariness, mingled with surprise, that we note the appearance of a work on the transmission of acquired characters. Lamarck's theory of evolution involved a belief in the thesis that acquired characters are transmitted. Darwin believed that evolution was due to the natural selection of both innate and acquired characters, and his theory of pangenesis was more than anything else an attempt (shirked by Lamarck) to provide a hypothesis to account for the transmission of acquirements. Darwin's suggestion that innate characters played a part in evolution as well as acquired ones paved the way for the great step taken by Weismann, who in his theory of the continuity of the germ-plasm laid the foundation of the modern, and still infant, science of heredity by doing away with the transmission of acquirements once and for all.

The step taken by Weismann is far and away the most important in the history of evolution, or at any rate of genetics, because it divides that history into two periods, in the first of which the problem to be solved was: "How do the characters of an organism get into the germ-cell which it produces?" whilst in the second the problem has become: "How are the characters of an organism represented in the germ-cell which produces it?"

Weismann showed that the problem of the first period was as unreal as the question about the apple dumpling which puzzled one of the Georges, by opening our eyes to the fact that the characters of an organism do not get into its germ-cells any more than the apple gets into its crust, but that both the germ-cells and the apple were there all the time.

Darwin, although he made a great step in advance of Lamarck by elaborating a theory of evolution which did not rest solely or even largely on the transmission of acquirements, did not go to the length of throwing that theory overboard altogether. It was left for Weismann to do this and thereby rid biology of a belief which has been the occasion of more futile discussion than any other that can be named. The full significance of Weismann's action is seldom appreciated, and cannot be done justice to here, but it is not too much to say that without it the problem of heredity would have been doomed to insolubility, and, to take a concrete example, that the Mendelian work of the last seven years would have been impossible.

Whether it is due to the general truth that a view once widely held is difficult to stamp out, or whether it is that there is something peculiarly fascinating in the belief that acquired characters are transmitted, the fact remains that there are still to be found isolated biologists and whole hosts of medical men who still hold it. However, as a belief in telegony, though rare, still exists, we perhaps ought not to be surprised at anything.

The author of the book before us, who is an engineer interested in sociology, believes in the transmission of acquirements, and has invented a theory of centro-epigenesis to account for the phenomenon. If the book is read it must be read in conjunction with the appendix dealing with this topic in Mr. Archdall Reid's "Principles of Heredity," and with Weismann's "Deszendenztheorie," which has been translated into English by Prof. J. Arthur Thomson.

A. D. D.

## PROBLEMS OF VISION.

*Zur vergleichenden Physiologie des Gesichtssinnes.* By Prof. E. Raehlmann. Pp. iv+58. (Jena: G. Fischer.) Price 1.50 marks.

THIS short pamphlet contains a discussion of three interesting problems in vision. It has long been known that the arrangement of the retinal elements in regard to the light falling upon the eye is reversed in the vertebrata and some invertebrates as compared with the majority of the latter. The author wishes to direct attention to the problem of explaining how in these "inverted eyes" the stimulus of light affects the retina. He puts forward the view that the morphologically outer end of the rods and cones acts in these cases as a reflector, and causes the light to re-enter the inner limb where the visual stimulus commences. In that sense, therefore, the vertebrate retina is no exception to the general statement that the rods always face the effective light rays. The isolation of the rods by pigment leads the author to an interesting account of the various forms of iris and of retinal pigments.

The second problem is the function of the tapetum. The significance of this brilliant structure has received little attention. Hatschek has attempted to show that it reinforces the incident light. The author, however, proceeds to show that the incident light is not effective even partially, but that it is the rays reflected from the concave and asymmetrical tapetal mirror which illuminate the inner portion of the peripheral retina. This area, weak in perception of detail, but

strong in detection of movement, catches the images of objects moving laterally. The tapetum would thus be put out of action by "blinkers," and, on the other hand, would aid carnivores both by detecting movements of their prey and by bringing these movements to the analysis of the central vision.

The third problem discussed in this pamphlet is that of colour-vision amongst insects. Insects are chosen because there seem good *a priori* grounds for believing that they possess colour-perception. The problem is raised in this form: Is any morphological peculiarity in the structure of these presumably colour-perceptive animals associated with this faculty, and can we picture their colour-field? The author points out the well-known composite nature of the rhabdoms or rods in the higher crustacea and insects, how they are composed of denser and more refractive plates alternating with feebly refracting layers, and how white light becomes broken up, partially absorbed and partially resolved into interference colours. He concludes that diurnal insects must view objects as we should see them through a tinted glass. Those coloured with the like tint would stand out from the rest, the majority would be blurred, and the whole field would be dim in any but a strong light. Hence, the author infers, the activity of diurnal lepidoptera only in very bright weather. Some of the suggestions made in this speculative essay are of great interest. Allied species often exhibit very different choice of stations, and comparison of their eyes may throw some light on why they do so. Again, the form of the rods of diurnal insects is certainly broadly different from that of nocturnal insects; the former are clear, the latter suffused with red pigment. But, on the other hand, both kinds of insect-eye show a similar lamellar structure, and it would require a far more rigid demonstration than is given by the author of this work before we could accept the view he takes, fascinating and suggestive as it is.

## A LANCASHIRE FLORA.

*The Flora of West Lancashire.* By J. A. Wheldon and A. A. Wilson. Pp. iii+511. (Liverpool: J. A. Wheldon, 60 Hornby Road, Walton; Ilkley: A. Wilson, 4 Eaton Road, 1907.) Price 12*s.* 6*d.*

WHEN the ravages of the jerry-builder are fast obliterating the comparative solitudes on the outskirts of our great cities, and the equally destructive, though more localised, irruptions caused by dock and railway extensions and industrial enterprises are slowly exterminating the flora of our countrysides, it is a matter for congratulation that there are to be found men like the authors of this flora, prepared to sacrifice hours of leisure and recreation in the task of cataloguing for future reference the plant inhabitants of such botanically doomed districts. As the authors point out, Lancashire is sadly deficient in such records, and the present result of their painstaking efforts is to be welcomed for that reason, if for no other.

The volume is, in the main, a catalogue of the plants of the district known in Watson's "Topographical Botany" as "Vice-County No. 60," embracing the West Lancashire spurs of the Pennines, the coast district between Carnforth, Morecambe and Lancaster, and the extensive flat lands reaching from the estuary of the Lune to that of the Ribble. The catalogue is prefaced by a summary of the general topographical and botanical features of the district, by a chapter on meteorology and climate, and a brief synopsis of the relation of plant distribution to latitude and to edaphic factors. The flora follows, as the authors say in their preface, "the conventional models," yet one could have wished that they had departed from these models—at least in a few fundamental particulars.

One of the most remarkable features of recent British floras is the inclusion of gymnosperms under the head of dicotyledons. It is incomprehensible to the general botanist that a taxonomy so archaic should be repeated so persistently in successive editions of the London catalogue, in local floras like the present, and even in the latest list of British plants compiled by Britten and Rendle.

Again, the value of this flora would have been greatly enhanced had the authors deemed it advisable to add some critical notes on local forms and varieties special to the district, on the model of Townsend's excellent flora of Hampshire.

Although they do not profess to give "a botanical survey" of the West Lancashire area, the authors have devoted nearly a quarter of the volume to what is to all intents and purposes a digest of that aspect of their subject—to the general reader by far the most interesting part of the book. Moreover, this section is illustrated by fifteen most excellent photographs of characteristic ecological features. One does not wish to depreciate the value of records of "first finds," nor the claim to recognition of the "first finders," but there remains a lingering desire for a more succinct treatment of such records—which, after all, can be only of local interest—and a fuller statement of the main general topographical features, a statement which the authors are, apparently, so well qualified to give.

It has been customary, for some unexplained reason, to include in local (and even general British) floras only dicotyledons (including—saving the mark! Coniferæ), monocotyledons, Pteridophyta and Characeæ. Messrs. Wheldon and Wilson have had the courage to include mosses, Hepaticæ and lichens, on which groups, if we mistake not, one at least of the writers is an acknowledged authority. It is unfortunate that they have not been able to enlist the aid of a fungologist and algologist, and so present us with a *complete* flora of the area.

It seems almost ungracious to direct attention to the many typographical errors, especially in the first quarter of the volume (over and above the few errata mentioned), and, too, the haphazard distribution of commas and full stops, authorities for species, and so on, but these criticisms are made with no intention of depreciating the merits of the work under review, but rather of indicating what we think are deficiencies and blemishes on what is otherwise a valuable contribution to the field botany of a hitherto neglected district.

## SELENOLOGY AND GENERAL ASTRONOMY.

(1) *The Moon in Modern Astronomy.* By Ph. Fauth, translated by Joseph McCabe, with an introduction by J. E. Gore. Pp. 160; illustrated. (London: A. Owen and Co., n.d.) Price 10*s.* net.

(2) *Astronomical Essays, Historical and Descriptive.* By J. Ellard Gore. Pp. viii+342; illustrated. (London: Chatto and Windus, 1907.) Price 6*s.*

(3) *Evolution of Planets.* By Edwin G. Camp. Pp. 166. (Bristol: T. Thatcher, College Green, 1907.) Price 1*s.* net.

(1) THIS volume contains Mr. Fauth's summary of his twenty years' selenographic work, together with a discussion of the many problems which face the selenographer of to-day. Mr. Gore's introduction is purely descriptive of the general classification of lunar features, of which he defines the general terms, thus enabling the non-astronomical reader to study Mr. Fauth's work with some measure of understanding.

The theme of the work is the substantiation of the author's conclusion that our satellite is covered with a thick layer of ice. Both the "meteoritic-bombardment" and the "plutonic" theories of selenological evolution are critically examined, and their fallacies exposed. In the first chapter the author gives an interesting historical survey of selenology from early Grecian times to the present, paying special attention to the various maps which have from time to time been published. In this connection he rather deprecates the possibility of photographs, even of the excellence now attained, being as efficient as the eye in delineating the fainter shades of difference to be found in the lunar landscape.

The second chapter discusses appearance and reality, going into details as to what can really be seen with certainty, and as to the best means to employ for selenographical work. The essential differences between terrestrial volcanic craters and the so-called "craters" of the moon are emphasised strongly, and this leads to the discussion of the terminology generally adopted by selenologists.

Under the headings "Light and Colour," "The Ring Mountains," and "The Remaining Elevations and the Rills" respectively, the next three chapters are devoted to a critical examination of the various lunar features, showing how the results obtained by an experienced observer are incompatible with the older theories of lunar evolution. In the next, and concluding, chapter (vi) we are introduced to the theory which, in Herr Fauth's opinion, best explains the multitudinous appearances seen on the moon, viz., "*the moon is covered with a thick layer of ice.*" This conclusion is not a novel one, but it probably has never been so ardently advocated as in the present volume. Probably our satellite obtained the thick coating of solid $H_2O$, around its globular nucleus, by accretion from the intensely cold depths of outer space; possibly minor meteoric bombardments occasioned the breaches through which the sub-glacial, warmer water was expressed and formed the "seas," the "walled plains," &c., which now make up the lunar surface. On this theory the author is able to explain the large number of lunar objects which twenty years of devoted study have revealed to him, and he promises in a future work to establish it further. In conclusion, he subjects to severe criticism the records of recent changes in certain lunar formations, and expresses his conviction "that no eye has ever seen a physical change in the plastic features of the moon's surface.

(2) Nine of the twenty-four essays in this volume have previously appeared in various astronomical journals; the others are now published for the first time. The range of subjects is extensive, including such items as "Primitive Astronomy" and "Modern Theories," "The Ringed Planet," and "The Stellar Universe," "The Names of the Stars," and "The Size of Stellar Systems," &c.

As all those who are acquainted with Mr. Gore's writings would expect, all the essays are very interesting and instructive, but some will probably attract more general attention than others. For example, Mr. Gore gives a most interesting account of Michell, a divine of the eighteenth century, who, amongst other matters, discussed the probable parallax and magnitude of the fixed stars in an original and suggestive manner, extensively justified by more recent researches, and who seems to have been lost sight of in the blaze of glory which attended his immediate successor, Sir William Herschel. The theories and observations of the latter are also discussed in the light of recent knowledge, in a style that cannot fail to interest even the general reader.

The essays on the light, the secular variation, the number, and the brightness and density of the stars are more of the general style, but, as treated by Mr. Gore, are certain to attract and maintain the reader's attention.

"A Possible Celestial Catastrophe," involving an illuminating discussion of the subject of dark bodies in space, and "The New Cosmogony," in which the "planetesimal hypothesis" is expounded, are typical of the more speculative essays, and here again the problems are clearly stated and judicially examined.

Generally speaking, Mr. Gore employs data which have accrued from the most recent investigations, and the value of the volume is enhanced by six reproductions from actual photographs taken by Profs. Barnard and Wolf, and the late Dr. Roberts.

(3) It is difficult to see what useful purpose this posthumous publication of Mr. Camp's notes will serve. The author, in respect to accepted scientific theories, was a confirmed iconoclast, and treated dogma with scant ceremony. Yet we find the following on p. 35:—

"That the earth is a cool, hollow sphere may have been inferred by many minds, but it has not yet been taught as a matter of fact. Such, however, it is, and such it can be proved to be."

Similarly, all the planets, and the sun, are hollow spheres, coal is not compressed vegetable matter, the interior heat of the earth's crust is caused by the friction between magnetic currents as they come in

contact with each other and with non-conducting material; and so the book proceeds throughout its four hundred and sixty-seven disjointed articles, which were originally written as "Ideas from Port Shepstone" for the *Natal Mercury*.

W. E. ROLSTON.

## OUR BOOK SHELF.

*The Climber's Pocket Book. Rock-Climbing Accidents, with Hints on First Aid to the Injured, some Uses of the Rope, Methods of Rescue and Transport.* By Lionel F. West. Pp. 79; illustrated. (Manchester: The Scientific Publishing Co., n.d.) Price 2*s.* 6*d.* net.

ACCIDENTS are possible even to the most careful climbers, and they may happen in places from which a disabled man cannot readily be extricated. In such a case Mr. West's handy little book will be of the highest value, for his directions are terse, clear, and adapted to the various circumstances in which a mishap may be critical—on the face of a cliff, in a narrow gully or "chimney," when crags have to be climbed, or narrow ledges traversed before reaching a position which is easy of access. He explains and illustrates by photographs the different modes of using the rope, and how, by means of it, the disabled man may be lowered down precipitous rocks, transported across snow slopes, and carried on a stretcher, readily improvised, when the going becomes easy.

We are also told the symptoms indicating the nature of an injury, what to do and what to avoid, the articles of general equipment, and the few simple medicines and appliances which a climbing party should carry with them. That party, Mr. West rightly declares, should not number less than three; four is better, but more than that on a rope much retards progress, and the climbers in front, especially if the party be divided, may dislodge stones which imperil those in the rear.

If a man chooses to climb alone he must take the risks, for a simple fracture may then mean a lingering death; and two are not enough, for if assistance be needed the injured man must be left to pass hours, perhaps a night, in solitude. Frostbite, snow-blindness, and mountain sickness are described, with instructions for treating them, and Mr. West gives some valuable hints on the best way of avoiding mountain dangers, with a chapter of "don'ts," of which we must be content to say that, were it more generally followed, accidents would be far less frequent.

*What Rome was Built With. A Description of the Stones employed in Ancient Times for its Building and Decoration.* By Mary Winearls Porter. Pp. viii+108. (London and Oxford: Henry Frowde.) Price 3*s.* 6*d.* net.

EVERY intelligent visitor to Rome feels more or less curiosity about the varied stones that were used in such profusion for purposes of construction and decoration. Ordinary guides and guide-books are prone to err in the identification of the stones, and still more in any attempt to trace their origin or explain their formation. To deal adequately with the subject needs, in truth, the knowledge of both antiquary and geologist. The writer of this work, without professing any originality, has carefully collected from both sources a great deal of interesting information, and has examined critically several collections of typical specimens, with the result that she has produced a little volume that ought to be decidedly helpful to the inquirer.

The nomenclature of the ornamental stones employed by the ancients is often perplexing, leading occasionally to downright error. Even so common a term as "alabaster" is apt to be a source of some confusion, inasmuch as it is applied to both the carbonate and the sulphate of lime. Still more confusing is the use of the word "serpentine," for the antiquary often applies it to the green porphyry of Greece, a material very similar to the well-known rock of Lambay Island, near Dublin. On such points of terminology, as on other matters, the writer may be safely trusted, for her quotations show that she has not failed to consult the highest authorities.

A list of works of reference is appended, but its usefulness would have been increased if the dates of publication had been generally given. In the few cases where dates are quoted, accuracy is not always conspicuous. Thus a paper by R. Swan on Paros is here cited as having been read at the British Association in 1877, whereas on p. 83 the date is given as 1887; but, as a matter of fact, neither is correct, for the paper was read in 1889, and in Section C, not G, as here stated. A little more care might also have been well spent in the arrangement of the matter. What can be the use of explaining the meaning of the word "breccia" in a note on p. 50 when it has already been explained in words almost identical on p. 37? But these are only trifling blemishes, which detract but little from the value of an interesting compilation. It is difficult to point to any other work on the subject equally convenient and trustworthy.

*Nature's Hygiene and Sanitary Chemistry.* By C. T. Kingzett. Fifth edition. Pp. xvi+527. (London: Baillière, Tyndall and Cox, 1907.) Price 7*s.* 6*d.* net.

THIS is a book written with a purpose, and the purpose is to proclaim the virtues of a certain disinfectant in which the author is interested. There is no secret about the matter; he shows us the axe he is grinding, and every now and then holds it up, as it were, that we may admire the nice sharp edge he is putting on the implement.

By "Nature's Hygiene" the author means the process of oxidation, as shown more especially in the absorption of moist atmospheric oxygen by certain terpenes, with the concurrent production of hydrogen peroxide and oxidised terpenes. Enormous quantities of these substances arise in forests; the peroxide destroys decaying vegetable matter, and the terpene-products act, in the author's view, as antiseptics.

The early chapters of the book deal with elementary chemistry, and lead up to the consideration of ventilation, fermentation, putrefaction, water supply, and the treatment of sewage. Thence we pass to theories of disease, and so on to the question of disinfection. Remembering that the author is writing for people who are presumed to be ignorant even of very elementary science, we may say, without endorsing all his opinions, that he gives an interesting and readable sketch of the various matters dealt with. It is marred, however, by vain repetitions; thus the author's views upon the question of whether microorganisms or their toxins are the *causa causans* of disease crop up about as often as King Charles's head did in the writings of Mr. Dick. Moreover, much of the book is ancient history; the footnotes teem with references to obsolescent matters dating back to the '70's and '80's of last century, whereas modern results are sometimes overlooked. Thus, although there are some notes upon argon and electrons, radium and radiobes, yet when we turn to the chapter on malarial fever to learn what our author has to say about the

work of Ross, Grassi, and others during the last few years, we find him talking of *Eucalyptus globulus*, and telling us that "Laveran and others claim that the disease is produced by certain microorganisms allied to the Flagellata, but this is contested by Tommasi-Crudeli." Certainly this is a book that requires to be read with discrimination. C. S.

*Étude sur les Foudroiements d'arbres constatés en Belgique pendant les Années* 1884–1906. By E. Vanderlinden. Pp. 79. (Bruxelles: L'Observatoire Royal de Belgique, 1907.)

A PHENOMENON of very frequent occurrence, and one that has been much studied, is the injury occasioned to trees by lightning, and yet we have no satisfactory explanation of the many difficulties that the problem presents. It must be admitted that these inquiries have not always been pursued on scientific lines, and the facts that have been collected and the theories that have been suggested need a thorough sifting and examination. This is the task to which M. Vanderlinden has applied himself with very considerable success. If he has not satisfied curiosity in all directions, he has at least overthrown some popular errors, limiting and indicating the field of strictly useful inquiry.

It has long been held that some trees are not liable to be struck by lightning. M. Vanderlinden examines this assertion, and finds that in Europe no kind of tree is free from this damage. Some kinds, such as the oak, the poplar, and some species of fir, are more frequently injured than others, but there are not sufficient data to show how far this result is effected by situation, by size, by exposure, or by the greater number cultivated. The causes which may be expected to influence the selective power of lightning are also investigated, but with only negative results. Among these we find the character of the soil, the chemical constitution of the timber, the proximity of water surface, the formation of the leaf, the shape of the tree, and particularly the character of the bark. In this last, the author thinks that possibly we have a source of explanation that has not been sufficiently examined. Trees possessing a smooth bark, such as beeches, are less liable to be struck than those having irregular, rugged, roughened surfaces, the external portions of which, becoming dry and dead, are bad conductors of electricity.

Other questions discussed are the manner in which lightning affects the tree, the character of the so-called spiral injuries, the actual combustion of the tree material, and the manner in which men and animals suffer injury when in the neighbourhood of trees that have been struck. The whole forms an admirable examination of a very scattered literature, and accurately exhibits the present position of an unexhausted inquiry. Detailed tables accompany the paper giving information concerning the locality, the number, and variety of trees, reported as being struck by lightning in the years under review.

*The Laws of Health. A Handbook on School Hygiene.* By Dr. Carstairs G. Douglas. Pp. vii+240. (London: Blackie and Son, Ltd., 1907.) Price 3*s.* net.

THIS should prove a useful book for school teachers and others interested in the important subject of school hygiene. Anatomical and physiological details are briefly dealt with, as the author justly remarks that there are several excellent manuals dealing with these subjects. On the other hand, the really important and fundamental portions of hygiene as applied to school life, such as ventilation, warming and lighting, and the fittings of the school buildings, the nutrition, ailments and deformities of the pupils, are discussed with sufficient fulness, and these sections are copiously illustrated with diagrams and drawings. In dealing with fatigue, we are glad to see the stress the author lays on a proper amount of sleep, and that he ascribes a good deal of the listlessness and inattention, &c., met with in public elementary schools to deficient sleep. We have nothing but praise for the chapters on the slight ailments of children, the eye and ear, and infectious diseases; even the "fourth disease" is referred to. The only omission we have noted is a reference to the cleansing and periodical disinfection of school premises. R. T. H.

## *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.]*

### The Wehnelt Kathode in a High Vacuum.

THE interesting experiments on the Wehnelt kathode in a high vacuum described by Mr. Soddy in NATURE for November 21, 1907 (p. 53), do not, I think, necessarily conflict with the experiments of either Dr. Wehnelt or myself, nor do they appear to vitiate the conclusions we drew from them.

The experiments by which Dr. Wehnelt showed that the negative leak from a lime-covered kathode was independent of the gas pressure were made with currents much smaller than those used by Mr. Soddy. When currents of the order of an ampere per square centimetre of kathode surface are obtained, the phenomenon appears to be accompanied by a glow round the kathode implying that ionisation in the gas itself is playing a part. Prof. J. J. Thomson ("Conduction of Electricity through Gases," second edition, p. 477) has shown that the potential fall required to produce ionisation by collisions with these large currents decreases rapidly as the current increases, so that even the comparatively small fall of 30 volts quoted from Wehnelt's paper would be sufficient to produce a considerable effect of this kind.

When the pressure of the gas falls below the value required to maintain this glow under the assigned conditions as to difference of potential, pressure, &c., there will be a sudden drop in the value of the discharge current. This appears to be what Mr. Soddy has observed.

I do not wish to imply that the negative emission is in all circumstances independent of the presence of gas in the tube. It is well known that the negative discharge from hot metals is particularly sensitive to hydrogen. In a recent paper (Phil. Trans., A, vol. ccvii., pp. 53 *et seq.*) I have described experiments which seem to prove conclusively that the leak from hot platinum is not due to traces of absorbed hydrogen. As the experiments in gases other than hydrogen show that the negative leak from hot platinum is independent of the pressure at low pressures, it is very unlikely that it is caused primarily by traces of any other of the common gases. These gases only appear to increase the fundamental electronic discharge from the hot kathode by a process involving the occurrence of ionisation by collisions.

The foregoing explanation of Mr. Soddy's result is only offered as a suggestion, for two reasons. In the first place, Mr. Soddy's letter is not sufficiently definite as to some of the salient facts, as, for example, the magnitude of the pressure before the current dropped. In the second place, there is a good deal about the behaviour of these Wehnelt kathodes which is imperfectly understood, and which merits further investigation.

O. W. RICHARDSON.

Princeton, N.J., December 7, 1907.

I AM glad to learn Prof. Richardson's view is much the same as that expressed in my letter to NATURE of November 21, 1907, that the currents in question are carried mainly by the residual gas, not by the electrons expelled from the kathode. Into the views that have been expressed in earlier communications it is therefore un-

necessary to enter; but certainly Prof. J. J. Thomson has recognised the important part played by the residual gas, for example, in his lecture reported in NATURE of March 22, 1906. So far as I have yet been able to see, the action of the residual gas in the passage of large currents is much the same whether a Wehnelt kathode or an ordinary electrode is used. There appears to be a definite pressure at which the conductivity is a maximum, and a steady diminution of conductivity when this pressure is either increased or diminished. I do not think, with large currents at least, there is a sudden drop in the discharge current when the pressure is gradually reduced. Of course in the experiment I quoted there was a sudden cessation of the current, but then there is a sudden absorption of the residual gas when the calcium volatilises. The practical difficulties in the way of maintaining a high vacuum in an apparatus containing incandescent bodies by ordinary methods probably led to the earlier view that it was possible to make a vacuum a good conductor by use of an incandescent kathode.

F. SODDY.

## British Association Seismology.

AN ancient Bogie has again appeared upon the scene. The object it has in view is to show that the seismological work done by the British Association is practically useless. It owes its existence to Prof. Bruno Weigand, of the Strassburg Kais. Hauptstation für Erdbebenforschung, and it was introduced to the notice of seismologists as a "Begrüssung" at the second International Seismological Conference. On this occasion, as a welcome to the British and other delegates, Dr. Weigand dilated at considerable length upon the defects of the instruments used by those who had kindly cooperated with the British Association. At Strassburg a Milne pendulum did not record so many earthquakes as a pendulum of the Reubeur-Ehlert type, and the records from the first of these instruments indicated very late commencements.

This statement, which month after month and year after year Strassburg has published in the form of registers, has just been emphasised in two new works on seismology, "La Science séismologique," by Comte de Montessus de Ballore, and "Earthquakes," by Prof. W. H. Hobbs. These gentlemen, who I do not think claim to have any practical acquaintance with seismology, candidly tell us that their information came from others. What Dr. Weigand has said about his experiences at Strassburg is no doubt absolutely correct. It is not, however, sufficiently complete; he ought to have added that, although records were not being obtained at Strassburg, they were being obtained from similar instruments in Britain and at stations in other parts of the world. As to whether a seismograph gives satisfactory results or not depends upon its foundation, its adjustment, and, amongst other things, upon the light which is used for photographic purposes. If the light is too high, halation steps in, and all small vibrations are eclipsed in a broadened line.

As Dr. Weigand correctly points out, a factor of great importance connected with the working of a seismograph is the speed with which record-receiving surfaces move. In the early form of the Milne instrument, unless great care was exercised with regard to the light and adjustment of the boom, in consequence of the slowness with which the paper moved, very small earthquakes or preliminary tremors might be lost by the thickening of the line. In the modern form of record-receiving surface, now in use for some years, where the paper moves at 24 cm. per hour, nothing of this sort takes place. The seismograph remains exactly as it was first designed, and with its new recording surface yields results as useful and accurate as those obtained from any other type of instrument, and this it does at a cost of less than 3*l*. per annum. An instrument of higher sensibility than the Milne pendulum cannot be used on soft ground, whilst one which uses a very large quantity of photographic paper per year is beyond the means of small observatories. I am quite content to continue with the instrument I now possess, and, in spite of all criticism, I have no desire to change the same.

JOHN MILNE.

Shide, December 30, 1907.

## The Photoelectric Property of Selenium.

IN the letter which appeared in NATURE of December 26, Prof. Minchin does not state what kind of air-pump he used to exhaust the tube containing the light-sensitive selenium "bridge." If he used a mercurial pump, the presence of mercury vapour would explain the great fall in resistance observed.

In a paper published many years ago (Proceedings of the Royal Society, 1876–7, vol xxv., p. 22), I showed that mercury combines at ordinary temperatures with selenium, producing a superficial film of comparatively low resistance. This effect is produced with vitreous selenium as well as with the granular or metallic form.

Selenium converted from the vitreous to the metallic form, in a vacuum free from the vapour of mercury, behaves like selenium rendered light-sensitive in the air in the ordinary way (Draper and Moss, Transactions of the Royal Irish Academy, 1876, vol. xxvi., p. 231). A specimen prepared *in vacuo* was found to have a high resistance, attributable, no doubt, to its spongy form; it was, however, highly sensitive to light.

RICHARD J. MOSS.

The Laboratory, Royal Dublin Society, December 27, 1907.

PROF. MINCHIN'S observation (p. 173) that the resistance of his selenium cells, or "bridges," when placed *in vacuo*, becomes enormously diminished is strongly suggestive of internal contact or short circuit, possibly brought about mechanically by the expansion of a small body of confined air in some part of the arrangement. Such short circuits occur not infrequently under ordinary conditions, and may generally be burnt out, and the cell restored to its original state, by the application for a moment of an E.M.F. of 50 volts or 100 volts.

Selenium cells have often been tested in a vacuum. They are supplied commercially, enclosed in highly exhausted glass tubes, by Dr. Ruhmer, of Berlin.

SHELFORD BIDWELL.

Beechmead, Oatlands Chase, Weybridge,
December 30, 1907.

## Echelon Spectroscope.

WHILST employing a thirty-three plate echelon spectroscope, constructed by Messrs. Adam Hilger for Prof. Schuster, my attention has been directed to a feature of the instrument which needs to be considered in drawing conclusions as to the nature of the light. Using an Arons mercury lamp as the source of light, the bright green line, for example, is resolved by the echelon into a bright and broad principal line with narrower companion lines on either side, and the principal line sometimes shows a narrow dark line not far from its centre.

Like others who seem to have observed the same effect, I supposed that the principal line showed reversal until I found that, on rotating the echelon slowly about a vertical axis, the dark line moves across the broad bright line, and disappears at the side; then another dark line appears at the opposite side, moves across, and disappears like the first; and so on.

These effects are probably produced by interference bands that have not been considered in the theory of the echelon, but have been described by Gehrcke ("Über eine Interferenzerscheinung am Stufengitter," *Annalen der Physik*, xviii., p. 1074, 1905).

If the echelon is tilted about a horizontal axis, parallel to the plates, these secondary bands become more inclined to the vertical, that is, to the direction of the slit, than the ordinary spectrum lines, and their mutual intersection gives to the spectrum lines a screw-like appearance.

A further investigation of these bands is being made, and it is hoped shortly to publish additional details of their behaviour that may help to explain their origin.

H. STANSFIELD.

The University, Manchester. December 26, 1907.

## A Point in the Mathematical Theory of Elasticity.

PROF. PEARSON has recently made a statement which if correct is of very great importance to engineers. He declares that the distribution of the stresses due to the water pressure on, and the weight of, a dam is entirely different in the case of a thin slab cut from the dam

than it is in the complete structure, because in the former case the slab can expand freely, whereas in the other case this lateral expansion is prevented.

If some portion of the total load was taken by the dam acting as a horizontal beam, this claim would not be challenged by me, but Prof. Pearson states that his proposition is true independent of any action of this character. On a question of pure mathematics it is no doubt very rash for a mere engineer to differ from Prof. Pearson, but as the point is of great practical importance I make the venture, since the statement appears to me to be opposed to the mathematical theory of elasticity as usually taught. The sole difference between the two cases lies in the fact that when the slab constitutes a portion of a complete dam it is subject to a certain normal stress which Prof. Pearson calls $\widehat{yy}$.

Now the characteristic of this stress is that it produces no appreciable shear in planes parallel to itself or in planes at right angles to itself. In fact, Prof. Pearson states that in both cases we may put $\widehat{yx}=\widehat{yz}=0$, and that $\widehat{xz}$ is identically the same in both cases.

Consider, then, the slab, taking first the case in which the sides are left free to expand, but in which stresses are produced in it due to the water pressure and its own weight. Taking $\widehat{xx}$ as the stress parallel to the horizon and $\widehat{zz}$ as that parallel to the weight, we have, Prof. Pearson says, the following equations which these must satisfy :—

$$\frac{\partial}{\partial x}\cdot\widehat{xx}+\frac{\partial}{\partial z}\widehat{xz}=0$$

$$\frac{\partial}{\partial x}\cdot\widehat{xz}+\frac{\partial}{\partial z}\cdot\widehat{zz}+\rho g=0.$$

Under these internal stresses the sides of the slab undergo a displacement $v=f(xz)$, say. This displacement, it should be noted, is everywhere finite and continuous.

Now apply, to the slab, forces $\widehat{yy}=\mathrm{F}(xz)$, so distributed as to cancel the above displacement, and we get the conditions of the equilibrium when the slab forms part of a complete dam.

Next consider these forces $\widehat{yy}=\mathrm{F}(xz)$ to act alone. The characteristic of the internal stress then produced is, as already pointed out, that $\widehat{yx}=\widehat{yz}=\widehat{zx}=0$, so that the conditions of internal equilibrium reduce to

$$\frac{\partial}{\partial x}\cdot\widehat{xx}=0$$

$$\frac{\partial}{\partial y}\cdot\widehat{yy}=0$$

$$\frac{\partial}{\partial z}\cdot\widehat{zz}=0,$$

These and the boundary conditions are obviously satisfied by putting $\widehat{xx}=\widehat{zz}=0$ and $\widehat{yy}=\mathrm{F}(xz)$ throughout. If, at the same time, the conditions of continuity are satisfied, this should be the solution. It would seem that the continuity of the material is necessarily satisfied by the fact that $v$, the displacement of the surface under the forces, is everywhere finite and continuous. If I am right in this, the stresses $\widehat{xx}$ and $\widehat{zz}$ should be the same in the complete dam as they are in the slab, but Prof. Pearson says this is not the case.

H. M. MARTIN.

Croydon, December 22, 1907.

## *LORD KELVIN: AN APPRECIATION.*

LORD KELVIN occupied for a long time a unique and cosmopolitan position as the universally venerated head of the physical science of the age. Where he did not himself create new knowledge, he constantly inspired discovery. Always accessible, always keenly attracted by the work of others and ready to learn, with universal interests, and mental activities untiring even to the end, he for more than half a century was the main practical scientific influence in this country; while for the latter portion of this period his point of view, through the generous advocacy of Helmholtz and other fellow-workers, became naturalised throughout the world. He was representative, more than any other person, of the combination of abstract scientific advance and mechanical invention which led to the still recent electrical transformation of modern engineering; he sustained and elevated industrial progress by the fire of intellectual genius.

In his earliest scientific work he was the interpreter of Faraday, at a time when support and mathematical elucidation of the intuitions of his genius were much required. In addition to special advances of his own into new domains, such as the theoretical prediction of electric vibrators and their laws forty years before they were utilised by Hertz, and the assertion of the thermochemical principles controlling voltaic batteries, he early became the founder, or rather restorer, of a school—the modern British school of physical science—which aims at moulding the course of general physical theories, even of abstract mathematics itself, by aid of intuitions drawn from exact formulation of the observed course of nature, assisted by illustrations such as may be gleaned even from the study of artificial practical mechanisms. A typical example of this kind of activity was the vortex theory of the molecular structure of matter, which he built on Helmholtz's fundamental discovery of the absolute permanence of vortical motions in a frictionless fluid medium; to a superficial view this is now in the main only an abandoned theory; but those most conversant with the history of the coordination of physical activities, which is the ultimate aim of the science, will allow that the vortex-atom theory was the first illustration that included any adequate idea of the type of interaction of the material atoms and the universal æther in which they subsist, and as such has been the direct ancestor of all subsequent advances towards the mental representation of ultimate physical reality.

In particular Lord Kelvin was the inspirer of Clerk Maxwell, his avowed pupil in all important respects, and was thereby an essential factor in that consolidation and reconstruction of physical science, on a refined electric, or subelectric, basis, which is still in progress, and has been a main glory of recent years.

In another region of his activity he combined delicate mathematical methods of investigation with broad industrial application of the results. It was largely the determined and prolonged struggle to carry through to success the enterprise of Atlantic submarine telegraphy that led to the invention of those appliances for exact measurement which afterwards made general electrical engineering feasible. In this new branch of applied science, his active perception of the essentials for progress assumed the form of generalship; most of the details of development naturally came from others, but he was always ready to emphasise the salient problems, and to acclaim, early and enthusiastically, such nascent inventions as would be pertinent to their mastery.

An example of his firm grasp of the connection of theory and practice is afforded by his work on the prediction of the tides. The recognition that the tidal oscillation is compounded of a limited number of simple harmonic constituents, of known periods, was an outgrowth of physical astronomy, and is mainly due to Laplace; the principle that any oscillatory movement arising from permanent causes is resolvable into simple harmonic constituents, and is to be treated on that basis in all exact science, was the fundamental contribution of Fourier. It remained largely for Lord Kelvin to combine these two principles, supplying the mechanical contrivances necessary for rapid computation, and thereby to control all that is requisite to be known about the tides. while avoiding the complexi-

ties, arising from the irregular forms of the oceans, that would choke any attempt at direct dynamical calculation in detail. Other examples of the same faculty are afforded by his fundamental improvements in ships' compasses and in deep-sea sounding; while his life-long work on problems relating to the speed of ships, the waves they produce and the energy lost in their formation, has been a chief influence in the rational study of the conditions and limitations of marine propulsion.

He will be known to future ages, possibly even more widely, as a main pioneer and creator in the all-embracing science of energy, the greatest physical generalisation of the last century. He was the first to grasp and insist on the universal dynamical, even cosmical, importance of the principle of reversible cyclic processes, which sprang almost in advance of its time from the genius of Carnot. Concurrently with Clausius he soon supplied the necessary logical adjustment of its thermal application; and by his own work, and his collaboration with Joule, he largely constructed the practical essentials of the fundamental, because unifying, modern science of thermodynamics. The depth and generality of the conceptions, which pervade his fragmentary and often hurried writings on this subject, have been recognised sometimes only after the same ideas have been slowly evolved afresh, and acclaimed in their varied applications as advances of the first rank, on the part of other investigators.

In Lord Kelvin there has passed away one of the last commanding figures, perhaps in genius and the variety of his activities as great and memorable as any, in the scientific and intellectual development of the nineteenth century. J. L.

## *LORD KELVIN AND THE UNIVERSITY OF GLASGOW.*

AT a college meeting in 1891, Sir William Thomson said:—"I have been a student of the University of Glasgow fifty-five years to-day, and I hope to continue a student of the University as long as I live." In 1899, when he retired from the professorship which he had held for fifty-three years, Lord Kelvin (as he had then become) applied to the Senatus Academicus to be appointed a research student. His name thus remained to the last upon the College roll, and in the list of those who have a right to pursue investigations in the laboratories of natural philosophy.

An academic connection so long, so intimate, and so fruitful is not severed without a deep sense of personal bereavement on the part of the survivors. The university, of which, since 1904, Lord Kelvin was the venerated head, was plunged into deep mourning by the news of his death. Special meetings of the court and senate, and of the executive of the general council, were held, and passed minutes of regret and sympathy. The regular classes were suspended; the courts were silent; the flag that usually waves high over the Kelvin drooped at half-mast. The new institute of natural philosophy which the Chancellor, at its opening in April last, took such pride in displaying to the Prince and Princess of Wales, was closed; and throughout the city, which regards the university's glories as its own, the signs of mourning were everywhere visible. Telegrams and messages from local public bodies, learned societies, and representative men, arrived hourly at Gilmorehill. The note of admiring affection for a great fellow-citizen was prominent in these, for Lord Kelvin was a freeman of the city, and a leader in its technical enterprises, no less than a teacher and investigator in the university. Hence came about a certain wistful acquiescence, on the part of Glasgow men, in the arrangement whereby he was to be laid to rest beside his intellectual peers in Westminster Abbey. The national tribute was felt to be right and fitting; though not a few were hoping that his burying-place would be in the City Necropolis, where his father and others of his kindred are laid.

In order that expression might be given to the *genius loci*, a memorial service was held by the university in the Bute Hall on Sunday afternoon, December 22, simultaneously with that held at Largs before the funeral company started on their journey southward with Lord Kelvin's body. The hall, which serves as the university chapel, was draped with black, and filled with a congregation of nearly two thousand mourners. All stood, as to the strains of the Dead March the long academic procession, representing the court, senate and other teachers, general council, and students, preceded by the ancient mace swathed in crape, filed in and occupied the stalls and platform. Many of the congregation wore the graduate's robe, and students, men and women alike, wore their undergraduate gowns of scarlet. The Vice-Chancellor, Principal MacAlister, presided, and read the lessons (Job 28, and 1 Corinthians 15) from his stall. The simple service of prayer and praise was conducted by two professors of the faculty of divinity (Drs. Reid and Cooper), and was marked by devout resignation, and by thanksgiving for a great example, rather than by the gloom of unrelieved mourning. The anthem Nunc Dimittis, sung by the university voluntary choir, and a special prayer for the university, that in it all science and scholarship might be consecrated to the honour of God and the promotion of human welfare, gave the characteristic notes. There was no sermon or funeral discourse; this will more fittingly be given hereafter. The venerable Lord Blythswood, the Lord Provost, Sir William Bilsland, the president of the faculty of physicians and surgeons, Admiral Bearcroft, Dr. William Wallace, Dr. George Neilson, and many other men of note in the west of Scotland were present. Relatives and others connected with the Chancellor's family, and the officials of the electrical manufacturing firm of Kelvin and White, which he founded, occupied seats near the daïs. The funeral march of Chopin closed the ceremony, as the university procession passed out of the hall into the darkness of the winter afternoon, and the silence of the courts that the Chancellor had loved so well.

Telegrams of condolence with the university were received during the week from Mr. Marconi, Glacé Bay; the University of London; University College, Nottingham; the Duke of Argyll, representing His Majesty the King; the Faculty of Science of the University of Rome: Prof. Egoroff, director of the Central Chamber of Weights and Measures, St. Petersburg; Principal Voinarowsky, of the St. Petersburg Electrotechnical Institute; the Chancellor of the Exchequer, Lord Rector of the University; Sir James King, Bt., Dean of Faculties; Rector Borgman, of the Imperial University of St. Petersburg; the Russian Physico-chemical Society; Rector Syniewski and professors of the Polish Technical College, Lvov; Rector Bagatcy and professors of the University of Charkow; Rector de Mbinski and Senate of the University of Lemberg; the Royal College of Surgeons of Edinburgh; the Senatus of the U.F. Theological College, Aberdeen; the students of physics of the University of St. Petersburg; President Dini, and the Faculty of Science of the University of Pisa; the University of Liverpool; the Ambassador of France; the Senatus of the University of Aberdeen; the St. Petersburg Society of Electrical Engineers; the pro-rector and professors of the University of Jurjew (Dorpat); &c.

## FLUCTUATIONS IN HIMALAYAN GLACIERS.[1]

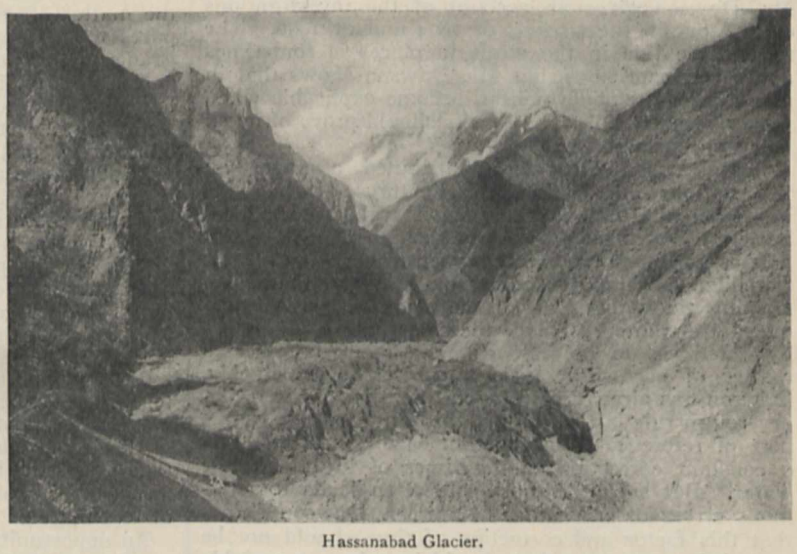
NEARLY half a century ago the glaciers of the Alps began to shrink. Their retreat was most rapid in the decade following 1860; since then it has been generally slow, and of late years the ends have been mostly stationary or oscillating. Traditional and other evidence exists of earlier fluctuations, and it suggests that the cycle of change is completed in about half a century. For some time past these fluctuations have been watched in various places, and an International Commission of Glaciers is now occupied in collecting and systematising evidence bearing on the secular and annual oscillations of the ice.

The glaciers in other parts of the world—the Caucasus, parts at least of the Himalayas, and of North America, even of the southern hemisphere—show signs of a recent retreat. As this is indicative of more than local causes, extended and accurate observations have become more than ever desirable. In 1905, Mr. Douglas Freshfield, so well known as a scientific geographer and explorer, urged the authorities in India to record the secular movements of the principal Himalayan glaciers. They undertook the task, and charged the Geological Survey with the collection and distribution of the observations. Last year twelve glaciers were examined, six in the Kashmir region, surveyed by Mr. H. H. Hayden; two in the Lahaul, and four in the Kumaon.

The report before us gives a general account of each glacier and its past history, so far as this can be ascertained, and describes the marks placed to measure its future movements, with sketch-maps and reproduced photographs. In the Hunza region, the glaciers reach lower levels—from seven to eight thousand feet—than in the Lahaul and the Kumaon, where they do not descend below about eleven thousand feet. They may, as usual, be divided into two classes—those flowing in valleys transverse to the trend of the range, and those the course of which is approximately parallel to it; the former, which have the more rapid slope, being the shorter, but descending lower; the latter, such as the Hispar and the Biafo, which attain lengths of twenty-four and thirty-nine miles respectively, being arrested at about ten thousand feet.

Of the six observed, no certain evidence of gain or loss could be obtained about the Barche and Minapin. The great Hispar glacier, traversed by Sir Martin Conway in 1892, has since then slightly retreated. The Hinarche glacier, the lower part of which was explored by the same traveller, has evidently advanced. This, however, may not mean much, for the people of the country assert that it fluctuates in a cycle of six years, advancing and retreating over a distance of some three hundred yards, and was at its maximum when Mr. Hayden saw it. The Yengutsa glacier, however, has gained about two miles in length since Conway's visit, and this, according to native testimony, by a sudden advance about two years before Mr. Hayden's visit, since when it has been stationary. The Hassanabad glacier, a year earlier, made a yet more rapid and extensive progress, for in the course of two and a half months its length was increased, on the lowest estimate, by six miles, but it is now stationary. The chief official in Hunza also stated that many years ago it had reached, and then retreated from, its present position. The accompanying illustration, from one of the sixteen excellent reproduced photographs in the first part, shows the end of the glacier at the time of the surveyors' visit.

The two glaciers in Lahaul, surveyed by Messrs. Walker and Pascoe, are both in the Chandra valley—one of them, the Sonapani, ending at about 13,000 feet above sea level, has in advance of it a desiccated lake-bed dammed by an old terminal moraine, below which are three similar moraines. The other glacier, the Bari Shigri—the boulder covered—has been already noticed more than once by travellers, and their accounts show it to have retreated considerably during the last seventy years. Of the four glaciers in Kumaon, examined by Messrs. Cotter and Brown, the Pindari is already well known to tourists. It descends from lofty peaks, but the ice appears to move rather slowly, and is not much crevassed. It is said to be retreating, but the surveyors could not succeed in obtaining any exact details. The Milam glacier was described early in the last century as the source of the Ganges. It is now about twelve miles long, but, as old moraines show, was once larger. The terminal ice-cave, about fifty years ago, was some 800 yards in advance of its present position. The Shankalpa glacier is much crevassed, and is probably retreating, though no old moraines are found much in advance of its present snout. Of the fourth, the Poting glacier, old terminal moraines exist lower down the valley, but no evidence was found of a recent retreat. Here also the excellent photographs and sketch-maps will make future movements of the ice easily detected.



Hassanabad Glacier.

These fluctuations, whenever they may occur, must be due either to an increased supply on the upper snow-fields, or to a diminished waste of the ice on the lower parts, or to a combination of both; though sometimes, as in the case of the Glacier Blanc and Glacier Noir in the Pelvoux district of Dauphiné,[1] one ice stream may be advancing while another is in retreat. That,

[1] Records of the Geological Survey of India, vol. xxxv., parts iii. and iv. 1907. Containing a Preliminary Survey of Certain Glaciers in the North-west Himalaya, by Officers of the Geological Survey of India. Part iii., Notes on Certain Glaciers in North-west Kashmir, by H. H. Hayden. Pp. 15; 23 plates. Part iv., Glaciers in Lahaul, by H. Walker and E. H. Pascoe; Glaciers in Kumaon, by G. de P. Cotter and J. Caggin Brown. Pp. ix+18; 26 plates. (Published by Order of the Government of India, 1907.) Price 1 rupee each.

[1] C. Jacob and G. Flusin, "Étude sur le Glacier Noir et le Glacier Blanc" (Commission française des Glaciers), 1905, ch. v.

however, may be a consequence either of a difference of alimentation or of the rate at which the ice is moving. Thus long and careful observations are necessary of the latter, of the nature of the advance or retreat, and of other matters, before sufficient data can be obtained to allow of the results obtained in different regions being compared, and their bearing on questions of general meteorology ascertained, but the investigation now begun in the vast northern mountain barrier of Hindustan must ultimately prove to be highly valuable. T. G. BONNEY.

## TIDAL INVESTIGATIONS IN CANADA.

THERE are few countries which possess so large an extent of navigable land-locked waters as does Canada. In such situations the tidal currents are apt to assume great importance, and the prediction of the tides is a task of great difficulty. The Canadian Government has naturally paid much attention to this complex subject, and they are fortunate in having so able an officer as Mr. W. Bell Dawson to place in charge of the operations.

In a paper on "The Currents of the Belle Isle Strait" (Government Printing Office, Ottawa, 1907), Mr. Dawson gives an account of the investigations carried out in the seasons of 1894 and of 1906. The run of the tide in the strait in places is sometimes apparently capricious, but Mr. Dawson shows that in many cases the abnormalities become explicable when properly examined. The results should prove of much value to mariners.

Mr. Dawson has also contributed a paper on "Variations in the Leading Features of the Tide in Different Regions" to the Royal Astronomical Society of Canada (July–August).

It is obvious that in the vast tract of navigable Canadian waters, the cost would be prohibitive of erecting tide-gauges at all the places at which tide-tables are wanted. Hence the calculation of the tides by reference to neighbouring harbours becomes a matter of necessity. It is a subject to which Mr. Dawson has already paid much attention. The ordinary rough rule is to multiply the range of tide at the port of reference by a constant factor, and to apply a constant correction to the times of high and low water. But such a simple rule often leads to enormous errors of prediction. Now Mr. Dawson shows that this factor and correction of time should not be regarded as constant, but should be taken as variable with the position of the moon.

The three points in which the position of the moon is influential are phase, declination, and parallax. These undergo variations in months of slightly different lengths, called the synodic, the tropical, and the anomalistic months. The corrections should be dependent on all these three periods, and thus they acquire a considerable amount of complexity. The most interesting point in Mr. Dawson's investigation is that he finds that, in some cases, it is one of the three factors which is dominant, and elsewhere it is another. So much is this the case that it is often possible to omit all corrections except those which are periodic in one of the three months. The determination of the dominant factor appears to be empirical, and no physical explanation is assigned for this curious conclusion. May we not suspect that when one or two of the monthly variabilities in the corrections are evanescent as regards time and height of high and low water, they are really affecting the tidal currents?

In any case these partially empirical corrections are found to be satisfactory in providing fairly trustworthy tide-tables, by reference to ports where there are tide-gauges and directly computed tide-tables.

G. H. D.

## EDUCATION AND RESEARCH IN INDIA.

THE battle between those who believe the sole duty of our professors in universities, colleges and other high educational institutions is to teach, and the best professor one who devotes the whole of his time to teaching, and those who believe that the highest and most fertile kind of teaching is that carried on by a professor who is an investigator as well as a teacher, has been fought out on many occasions and in many places.

Fortunately the latter view in late years has largely prevailed over the former, though the battle has still to be actively carried on in many places. The universities of Europe, at all events those which are the most progressive and of greatest importance, have accepted the fact that in the selection of their professors they must now take only such men as have given distinct proof of capacity for original work in one or other of the great departments of knowledge, and who may be expected to continue their original researches at every possible opportunity.

Unfortunately, in England this spirit has not always been acted on, and the condition of a good many of the institutions devoted to the highest culture is in the matter of research most unsatisfactory, and compares most unfavourably with institutions of similar grade on the Continent.

Nor, indeed, is this lack of original work in England confined to what may be called centres of the highest intellectual activity, but it largely pervades educational and technical institutions of all grades, and it is stated that in many cases where the management of such institutions is in the hands of committees, whose members are distinguished mainly by their success in trade, original research on the part of the staff is practically barred, and, if a professor or teacher is known to be an enthusiastic investigator, he is at once considered to be one who is not doing full justice to the students entrusted to his charge.

It is to be hoped that such instances will become more and more rare as the proper functions of a teacher are better understood, and it is for our universities, and for all educational institutions more or less controlled or influenced by Government, to take the lead in this matter and to insist on the inseparability of research from the highest branches of teaching.

An opportunity of taking such a stand and of doing an almost incalculable amount of good to the higher teaching of a country now appears to lie in the hands of the Indian Government. For a good many years India may be said to have been suffering from an educational unrest, for it was understood by all those who had studied the subject that Indian education had been working on unfortunate lines. Lord Curzon, during the time he was Viceroy, was the first who boldly faced a very difficult problem, and under his direction Indian education was placed upon a much more satisfactory basis. The changes brought about by Lord Curzon's action were very numerous; primary education was largely extended and made more practical, female education was fostered in every possible way, secondary education was also improved, and, lastly, university education was dealt with. Under a new Indian University Act a complete set of new regulations has been prepared, and speaking generally of these regulations it may be said that they have aimed at, first, the influencing of the characters of the students in the colleges and high schools, and, secondly, at securing a practical rather than a book knowledge of the subjects dealt with.

It may also be mentioned that, in cases where a science is being studied, the regulations require each student to have had personal practical instruction

and so far as possible to be practically examined. In the case of the higher degrees, such as D.Lit. and D.Sc., original work on the part of the student is an essential preliminary to his getting the degree, and even with lower degrees provision is made for anyone showing any practical originality to be excused a certain part of the usual theoretical book work.

It is, of course, understood that these regulations will require a stronger professorial staff to man the colleges of the universities than if merely theoretical instruction had to be given. A good many of the colleges attached to the Indian universities, indeed all the largest and most important, are directly managed by the Indian Government, and it is on the action of this body that to a large extent the effective working of the new Indian University Act will depend. The colleges must be dealt with liberally in the matter of staff, or the Act will be inoperative, for if Government colleges, with the resources of Government behind them, do not take the lead, it is useless to expect any others to work up to the desired standard.

An important article in the influential Indian newspaper, *The Pioneer*, of October 31, describes the condition of things in the Indian colleges as being rather critical at the present time. The following is an extract from the article :—

"The first commotion created by Lord Curzon's measures of University Reform has died away long ago; but it must not be overlooked that the work merely initiated by new Acts and sets of Regulations has yet to be actually done, and that rather momentous issues depend on the spirit in which it is done. We are reminded of this by certain papers of a controversial nature, written by members of the Bengal Educational Service, into which we have been allowed an insight. The controversy on the face of it would appear to be one of purely local interest, turning on the question whether the present professorial staff of the Presidency College, Calcutta, is adequate to the demands made on College teaching by the new Regulations of the University. But a perusal of the papers shows that matters of deep importance—the future of all teaching, learning and research in this country are involved in the discussion. An educational officer specially deputed by Government to report on the state and requirements of the Presidency College maintains that if the College is to satisfy the new demands on teaching the Science Professors must at once largely curtail the research work in which they have been indulging in the past, and another officer, closely connected with the College, in endorsing these remarks, tells us that research in the Presidency College has of late become 'something of a bogey,' even demonstrators and assistants being 'involved in researches.' This, he assures us, has led to neglect of pure teaching, and the first measure demanded by the new era of higher education is that the entire staff, from the senior professors downwards, should put aside their researches which, as far as the interests of the College are concerned, are not only useless but positively injurious. Against these views the Science Professors maintain that they and their subordinates have not neglected, and do not mean to neglect, 'teaching,' but that research and training in the methods of research constitutes an important, in fact essential, element in all higher stages of instruction. It is evident that what is being discussed here is no less than the entire future character of the upper sections of our large Colleges and the standing of their Professors. Is it to be a principle recognised, and eventually to be enforced, that Professors lecturing to B.A., B.Sc., M.A., and M.Sc. classes must limit themselves to *mere* teaching, whereby the antagonists of research evidently understand the assiduous inculcation into the minds of students of established facts and theories with the special aim of training the recipients of knowledge rapidly to reproduce in writing at examination time as much of the matter committed to memory as they can possibly manage; or should higher teachers in our Colleges be encouraged, possibly definitely expected, to combine with such teaching efforts to rouse in their students the appetite and capacity for original work and research? The latter alternative, of course, would imply that the men to whom higher teaching is entrusted should not be mere schoolmasters, but should themselves take some active part in the advancement of knowledge and learning."

It is greatly to be hoped that the Indian Government will seize the opportunity and properly strengthen all its colleges with professors who are investigators as well as teachers, and thus at once set a proper standard for the highest education in India. On the action taken now the future of Indian education largely depends, and on the giving of a proper education to the future leaders of the Indian community will depend the peace, progress and prosperity of our Indian Empire.

## NOTES.

WE understand that Sir Norman Lockyer has been in communication with the French Minister of Public Instruction with the view of securing active support for the science section of the Franco-British Exhibition to be held in London this year. The Minister has referred the matter to the Paris Academy of Sciences, and it is hoped that the result will be a satisfactory and substantial representation of scientific work in France at the forthcoming exhibition. The various divisions of the British section of the exhibition were described in NATURE of November 21, 1907 (p. 67). This section was instituted with the assistance of the British Science Guild, and is in the course of organisation by a committee including leading representatives of all branches of pure science. The British committee has been given an area of eleven thousand square feet, gratis, for the purpose of exhibiting apparatus, appliances, and results of scientific research. This free grant of space is equivalent to a gift of about 3000*l*., and in addition the committee has been granted a sum of money in aid of the science section. The executive committee of the British side of the exhibition has thus provided a very favourable opportunity of exhibiting some of the achievements of scientific research and enlightening the general public as to the instruments or methods employed. It is the duty of the men of science of Great Britain to show appreciation of this generous treatment by assisting the committee in every way within their power to make the science section of the exhibition instructive, illuminating, and inspiring to the many thousands who will visit it.

SIR GEORGE DARWIN, K.C.B., F.R.S., has been elected a foreign correspondant of the Paris Academy of Sciences in the section of geography and navigation. Lord Brassey has also been elected a correspondant of the academy.

PROF. RAPHAEL MELDOLA, F.R.S., past-president of the Chemical Society, has been elected president of the Society of Dyers and Colourists in succession to the late Sir W. H. Perkin.

IT is announced in *Science* that Mr. Andrew Carnegie has added 400,000*l*. to the endowment of the Carnegie Institution of Washington.

SIR OTTO JAFFE, president of the Belfast Natural History and Philosophical Society, has taken preliminary steps to form a committee to honour the memory of Lord Kelvin by erecting a statue or other suitable memorial in his native city of Belfast.

WE regret to see the announcement of the death of Sir Alfred B. Garrod, F.R.S., in his eighty-ninth year. Dr. Garrod graduated as M.D. of the London University

in 1843, and became a Fellow of the Royal College of Physicians in 1856. He was elected a Fellow of the Royal Society in 1858, and received the honour of knighthood in 1887.

THE Belgian Government is organising an Arctic meteorological expedition which will start next summer. The *Revue scientifique* announces that the expedition will be under the command of M. Georges Lecointe, director of the Royal Observatory at Uccle.

REUTER'S representative has received details regarding the Antarctic expedition which is being organised by Dr. Jean Charcot, who hopes to start in July, and expects to be absent for two years. Sufficient provisions to last three years will, however, be taken. The expedition is bent on scientific work. The best route to the Pole is, Dr. Charcot thinks, by way of the Ross Barrier, but this he regards as belonging to English explorers, and does not propose to travel that way. On reaching the Antarctic it is proposed to return to Graham Land, and endeavour to reach Alexander Land, where it is hoped a barrier similar to that of Ross's will be found. The expedition will then endeavour to go as far south as possible. An important part of the equipment will be motor-sledges, which are being built by the Marquis de Dion. With these sledges experiments will be made in the Alps during this winter. The ship for the expedition will be specially strong in view of the ice pressure, and will be of barquentine rig, with compound engines of 550 horse-power. She is to be 135 feet in length, with a beam of 30 feet, and will carry 230 tons of coal and 100 tons of provisions. The crew will consist of twenty-two men, ten of whom were members of Dr. Charcot's last expedition. The scientific staff, in addition to the leader, will number three naval officers, two zoologists, one geologist, and one physicist for magnetic and photographic work. The French Chambers have voted 12,000*l.*, while another sum of equal amount will also be voted by Parliament. Private subscriptions have yielded 2600*l.*, and Dr. Charcot is endeavouring to get a further 3400*l.* The Academy of Sciences has prepared the scientific programme, and the Committee of Missions of the Ministry of Public Instruction has drawn up a favourable report on the subject of the proposed journey. The Marine Department is giving the necessary coal and a valuable collection of scientific instruments, while the Oceanographical Institute of Paris, founded by the Prince of Monaco, is also helping.

IN his presidential address to the Royal Society on November 30, 1907, Lord Rayleigh referred to a movement to promote the publication of standard scientific works in embossed type suitable for the use of the blind. Mr. H. M. Taylor, F.R.S., has written out the whole of Mr. C. Smith's "Elementary Algebra" in Braille type; and the embossed edition of this work, consisting of five large royal quarto volumes, containing in the whole eight hundred pages, has been published by the British and Foreign Blind Association at the price of 16*s.* 6*d.* The blind who are interested in subjects of a scientific character are heavily handicapped, because an embossed copy of any book occupies a much larger space than a printed copy of the same book, and is therefore expensive to produce. The result is that though books in embossed type are needed on such subjects as mechanics, physics, astronomy, chemistry, and geology, very few blind persons could afford to purchase these books if their prices were comparable with that at which the embossed edition of the algebra has been published. Accordingly, a fund has been formed to assist the publication, for the use of the blind, of embossed books on scientific subjects at prices which would not be so high as to be almost prohibitive. This object would be attained by making grants from the fund to Braille printers towards the cost of embossing the plates from which the books are printed. It is thought that 600*l.* or 800*l.* would form a fund large enough to test the usefulness of the scheme, and would be ample for an experiment to last three or four years. The sum of about 300*l.* has already been subscribed or promised in support of the scheme. Donations may be paid to the secretary, Mr. H. M. Taylor, F.R.S., Trinity College, Cambridge, or direct to the "Embossed Scientific Books Fund" at the Cambridge branch of Messrs. Barclay and Co.'s Bank.

THE weather for 1907 affords several features of interest, and the results obtained for London from the observations of the Meteorological Office probably differ somewhat from the common expectation. The aggregate rainfall for the year is 19·5 inches, which is 4·9 inches less than the average for the past thirty-five years. The only months with an excess of rain were April and December. Rain fell on 162 days, and one of the special features of the year was the great frequency with which rain occurred. In October rain fell on twenty-two days, although the aggregate rainfall for the month showed a deficiency of 0·47 inch on the average. The mean temperature for the year was 50°·2, which is 0°·1 above the average. The highest mean in any month was 60°·8, in August, and the mean for each of the three summer months was considerably below the normal. The lowest monthly mean was 38°·5, in February, and with this exception all the six winter months had a temperature in excess of the average. The total range during the year was 57°, the highest temperature being 80°, in September, and the lowest 23°, in January. There were during the year only thirty-four frosty nights, and of these thirty-three occurred in January to March. The sun shone for 1234 hours, which is ninety hours in excess of the average. The Registrar General's returns show that the death-rate for the year was 15·2 per 1000 persons living; this is probably the lowest on record, so that however unpleasant the weather for the year may have proved, there has been a decided gain on the score of mortality.

THE contents of the first three numbers of the Records of the Indian Museum include a large number of papers, chiefly devoted to invertebrates, among which attention may be directed to a series, by Dr. Annandale and others, on the fauna of brackish-water pools at Port Canning.

IN the course of a paper on a collection of fishes from Victoria (Australia), published in the October (1907) issue of the Proceedings of the Philadelphia Academy, Mr. H. W. Fowler describes two new species of sea-horse, which, together apparently with the New Zealand *Hippocampus abdominalis*, are referred to the new subgenus Macleayina, on account of the greater number of long dorsal fin-rays in comparison with the more typical representatives of the group.

THE barnacles in the collection of the U.S. National Museum form the subject of a long paper by Dr. H. A. Pilsbry constituting Bulletin No. 60 of the museum. Only the pedunculate group and the members of the sessile family Verrucidæ are, however, dealt with in this communication. Hitherto the pedunculate species recorded from American waters number about a dozen, while the Verrucidæ have been unknown; the author is now enabled to raise the numbers of the former group to fifty-six, and to add five species of the latter.

IT has long been a matter of common knowledge that squirrels aid the forester by burying nuts, of which some sprout and ultimately develop into trees, but that he is also indebted to earthworms for aid of a similar nature is claimed by Mr. E. A. Andrews in the November (1907) number of the *American Naturalist* to be a new discovery. In America it appears that the dry, flat fruits of the silver-maple are frequently employed by worms to plug the apertures of their burrows, in the fashion long since described by Darwin. In districts too dry for them to germinate under ordinary conditions, a certain proportion of maple-seeds thus drawn into their holes by the worms were found to sprout and grow into seedlings, and although these ultimately perished under the influence of the late summer drought, the author is of opinion that under less unfavourable conditions a certain number would survive. Worms, he concludes, "probably more than amend, by planting trees, the damage with which they are credited through destroying seedlings in gardens."

EARLY in 1906 Prof. W. B. Benham communicated to NATURE (vol. lxxiii., p. 559) a note to the effect that the doubts expressed a short time previously with regard to the alleged carnivorous habits of the kea were not justified by the facts. Since that date he has been endeavouring to obtain more definite information on the subject, and the results of his investigation are published in the Transactions of the New Zealand Institute. A second investigator, Mr. G. R. Marriner, of Canterbury College, has likewise been pursuing inquiries, apparently independently, on the same subject, a summary of which is also published in the same volume. Both writers are in accord in regarding the accusation against the kea of worrying sheep for the sake of feeding on their flesh as now fully proved, and both likewise agree that the prime object of attack is not the kidneys and kidney-fat. Mr. Marriner, in addition, records some very interesting facts concerning the breeding-habits of this bird, notably that the eggs are laid and the young reared in mid-winter at an elevation of between three and four thousand feet above sea-level, where the winter cold is intense.

RATS, in connection with plague, form the subject of a pamphlet and two articles recently published in India. In the first number of Memoirs of the Indian Museum, Dr. W. C. Hossack gives an account of the species of rats found in Calcutta, illustrated with several coloured and other plates, and a key to their identification. The so-called Indian mole-rat (*Nesocia bengalensis*) appears to be the species most abundant in the Indian metropolis, where it is probably the one most concerned in the dissemination of plague, as it is extremely common in grain-stores, which are notorious as being centres whence the disease has spread. Originally a field-hunting, grain-storing species, it has in Calcutta become a parasitic inhabitant of stables, grain-stores, &c. "Aids to the Identification of Rats connected with Plague" forms the subject of a pamphlet, by the same author, published by the trustees of the Indian Museums, and printed at the Pioneer Press, Allahabad. Finally, to the third part of another new zoological journal—Records of the Indian Museum—Captain C. A. Gourlay contributes a note on the rats of Dacca, eastern Bengal, where the black rat (*Mus rattus*) is the most abundant species.

No. 18 of the *Bulletin biologique* (Dorpat) contains an editorial article on the need for exhibitions devoted to modern biological technique. It is pointed out that the progress of biological science is now so dependent upon improvements in technique, while the methods in use are so varied and elaborate, and demand an acquaintance with so many branches of science, that without exhibitions of this nature it is almost impossible for workers to keep thoroughly abreast of the times, or to find out in what direction improvements are required. Histology, for example, cannot advance without the aid of chemistry, while the physiologist is largely dependent upon the aid of the mechanician. Similarly, there is a close connection between the study of the tissues and minute structure of animals and optics. It is recommended that an exhibition of this nature should be divided into the following main sections:—(1) methods of collection; (2) the care of living animals and plants; (3) preservation of specimens; (4) transport of living organisms; (5) anatomical methods; (6) methods of microscopic work; (7) methods of studying development; (8) methods of chemical investigation of animal structures; (9) physiological research; (10) the methods of bacteriological investigation; (11) methods of illustration; (12) modelling; (13) museum installation and arrangement.

To the *Times* of December 26, 1907, Sir T. Digby Pigott contributes further information concerning the luminous owl recently seen in Norfolk, from which it appears that the phenomenon was observed by several independent witnesses. A letter from a Welsh fisherman is quoted to the effect that on the night of December 12, 1907, the woollen garments of the writer and his companions were observed to be luminous, and that such phenomena have long been known is demonstrated by an extract from a work published in London in 1704. A very important piece of evidence appeared in the issue of the *Times* of the same date, with the signature of "A Country Teacher." In this the writer states that in February, 1890, he first noticed a luminous appearance in a pair of barn-owls, which then inhabited a farm-building near his school, in Somersetshire. "I saw the luminosity several times," he writes, "but it was not so bright as Sir Digby Pigott's correspondent observed, and usually lasted only for a short time, though I could see the birds flying about after the luminous gleam had ceased. I never saw both birds luminous at the same time, and I am unable to say whether the male or female, or both, possessed this power. . . . I thought the luminosity might be connected with the electrical condition of the atmosphere, but though it was usually brightest and lasted longest when the electrical potentiality of the atmosphere was highest, it was not always so. . . . I could observe nothing to indicate that the luminosity was under the control of the owl." The writer also mentions that the phenomenon was perfectly familiar to the children in his school, who spoke of the bird as a "glim ullert."

THE importance of cacao cultivation in Grenada is evident from the report for 1906–7 of Mr. R. D. Anstead, superintendent of the botanic station. Plots have been established in five districts with the view of instructing peasant proprietors, and some of the planters have laid out large experimental areas on their estates for carrying out manurial tests. Seedling sugar-canes, of which the variety D. 95 was distributed, cacao, coffee, and bananas were the economic plants chiefly in demand, also seeds of Castilloa and Hevea. A feature of the report is the inclusion of several photographs. The collection of palms, amounting to eighty named species, contains many valuable kinds for the seeds of which there is a brisk demand.

PROF. A. C. SEWARD contributes to the Transactions of the Geological Society of South Africa, vol. x., a description of a collection of Permo-Carboniferous plants from Zululand and Natal. The material contained a large number of specimens referable to Glossopteris, but few of the forms were distinct. Sporangia were discovered on some of the leaves of *Glossopteris indica*, but this does not preclude the possibility of the genus being a pteridosperm; in this respect the association of small winged seeds with the leaves was noted. Other specimens referred to are the genera Phyllotheca, Bothrodendron, Vertebraria, and Cordaites. The specimens do not furnish sufficient evidence for determining the precise horizon in the Permo-Carboniferous system of the coal-bearing strata of Zululand and Natal.

THE Memoirs of the College of Science and Engineering, Kyoto Imperial University, Japan, of which the current issue (vol. i., No. 3) has been received, contains original memoirs by members of the University. Of the thirteen papers, eleven are written in English and two in German. The subjects dealt with comprise the equilibrium between reciprocal salt pairs, reaction between carbonic acid and lead acetate in an aqueous solution, experiments on the utilisation of scrap metal, formation of amines from the halogen imido esters, the refining of copper, electrolytic dissociation of partially neutralised weak acids, short-period magnetographs, the theory of the rotary converter, Beckmann's rearrangement, determination of the solubility of a given substance by means of Pulfrich's refractometer, and dynamometer car experiments. The varied nature of this list affords an indication of the large amount of attention that is now being devoted to research work in pure science in Japan. Of the papers dealing with applied science, that by Mr. D. Saito on the refining of copper should be carefully studied by metallurgists. The author has made a systematic study of the process of dry refining, his investigations having been made upon the blister copper from the Beshi mine in Japan. The blister copper, which is comparatively pure, is refined in a reverberatory furnace using coal as fuel, and the author finds that the greater part of the impurities is oxidised in the earlier stages of refining. Thus, after the end of the first rabbling, the copper contains only 0·03 per cent. of iron and 0·003 per cent. of sulphur, whilst after the second rabbling the iron contents remain almost unchanged, and the copper is practically free from sulphur. If the copper could be re-melted more quickly and the third rabbling period dispensed with, there would be a great economy in fuel and labour. The effect of the first poling is so great that the second poling seems unnecessary, or at least could be shortened.

MR. J. W. PATTERSON, of the Technical College, West Hartlepool, has sent us two very successful colour photographs of rock sections taken between crossed Nicols. They were taken by the Lumière autochrome process, the illuminant being an electric arc light, and reproduce very satisfactorily the interference colours given by plagioclase felspar, augite, and olivine. It is obvious that this places in the hands of teachers of petrology and geology a very useful aid for illustrating lectures. Autochrome photographs are most successful with slides which are fairly transparent, and should be inspected in a strong light. Mr. Patterson has also obtained photographs of the interference figures yielded by uniaxial and biaxial crystals in convergent polarised light. Some weeks ago we saw a series of colour photographs of this kind exhibited in Kelvingrove Museum, Glasgow. Three-colour photographic plates appeared two years ago as illustrations of an annual report of the Geological Survey of the Transvaal, and about the same time Prof. E. J. Garwood showed some colour lantern slides of rock sections at the Geological Society, which were the finest of their kind we have seen. They were taken by the Sanger Shephard process, we believe. Undoubtedly methods of colour photography will prove to be of great use in reproducing microscopic slides, not only of rocks, but also of other subjects.

IN *Symons's Meteorological Magazine* for December, 1907, Mr. W. Ellis, F.R.S., formerly superintendent of the magnetical and meteorological department of Greenwich Observatory, gives a useful summary of Greenwich air-temperature observations published for the sixty-five years 1841–1905. The lowest mean daily temperature, 37°·47, is reached on January 12; after February 12 the rise towards spring begins, receiving, however, a slight check in the last week of April. The highest mean daily temperature, 64°·01, is reached on July 15; after August 13 there is a continuous fall to the minimum of winter. The mean annual temperature is 49°·56; the warmest year is 52°, in 1868, and the coldest 46°·28, in 1879. The mean monthly temperature is 38°·6, in January, and 62°·7, in July. The absolute highest reading was 97°·1, on July 15, 1881, and the absolute lowest 4°, on January 9, 1841. The observations give no information on secular change, for which purpose a much longer period than sixty-five years is necessary; there are several interesting differences shown by dividing the series into groups, but Mr. Ellis states that these are clearly due to accidental causes. Nor is any influence traceable to sun-spot variation, which the author considers is practically insignificant in all questions of weather change.

AT the meeting of the Royal Academy of Sciences of Amsterdam of October 26, 1907, an interesting paper by Dr. E. Van Everdingen was read on the relations between mortality of infants and high temperatures. It had been previously pointed out in a paper published by the Statistical Bureau of Amsterdam that a distinct maximum in the mortality of children under one year of age existed in the summer months, but an endeavour to find any connection between this maximum in various places and the monthly means of temperature only led to a negative result, although it was still thought probable that the mortality was due to fluctuations of temperature. Following up this idea, Dr. Van Everdingen tabulated the meteorological data for various places in several different ways, one of which was to extract the days on which the temperature exceeded 25° C. between the middle of one month and that of another. In this case the agreement between the deviations of mortality and the number of hot days was so satisfactory that little doubt remains that the high temperatures must be considered as the cause of the increased mortality. The author expresses the hope that, with the aid of other temperature limits and possibly with other methods of grouping the observations, those competent in medical matters will feel inclined to trace the more direct relations of the phenomenon.

IN the *Physical Review* for November, 1907, Mr. W. P. White, of the geophysics laboratory of the Carnegie Institution at Washington, makes a thorough examination of the potentiometer methods of measuring temperature by means of the resistance thermometer or the thermoelectric junction, in order to determine the best arrangement to use in melting-point measurements. He comes to the con-

clusion that the thermoelectric method is the better, that the best time of swing of the galvanometer is five seconds, and that greater use should be made of galvanometer deflections than is done at present, so as to reduce as far as possible potentiometer manipulations. Slide wire potentiometers should be avoided, switch instruments being much more satisfactory, and leakage disturbances should be prevented by surrounding the circuit with a continuous or nearly continuous metallic shield.

THE September (1907) number of *Terrestrial Magnetism and Atmospheric Electricity* contains an abstract, by Mr. J. A. Fleming, of the results obtained by the Ziegler Polar Expedition of 1903–5. Astronomical, survey, tidal, meteorological, and magnetic observations were made during one year at several stations in the Franz Josef Archipelago. Two new maps embody the results of the survey, and indicate the two channels by which the tidal wave from the Atlantic reaches the archipelago. The mean barometric pressure was 29·6 inches, and the mean temperature 8° F.; the mean declination 22° east, the dip 83° north, and the total intensity 0·57 C.G.S. unit. The morning maximum of easterly diurnal declination occurred between five and six o'clock, and the afternoon minimum between eight and nine o'clock.

THE employment of the conversion temperatures of crystallised salts as fixed points in thermometry has been shown recently to possess a real practical value, sodium sulphate having been shown to give the point 32°·383, and sodium bromide 50°·674, both on the international hydrogen scale. In a recent number of the *Zeitschrift für physikalische Chemie* (December 3, 1907) Messrs. T. W. Richards and Franz Wrede put forward manganese chloride, $MnCl_2+4H_2O$, as a suitable substance for another fixed point. One re-crystallisation of the commercially pure salt is sufficient to give a point within 0°·06 of its final value, and after six re-crystallisations the point is fixed to within 0°·001 C. A simple and effective form of thermostat is described and figured, by means of which the correction for the emergent column is reduced to one or two thousandths of a degree. The transition temperature of the tetrahydrate into the dihydrate of manganese chloride is finally given as 58°·089, with a limit of error of ±0°·005.

THE number of the *Zeitschrift* referred to above contains a paper by Mr. A. Hantsch giving the result of experiments on the cryoscopic behaviour of sulphuric acid. It is shown that, as a criterion of purity, the cryoscopic method far surpasses the ordinary analytical method. The pure monohydrate $H_2SO_4$ melts at 10°·46, and the addition of either water or sulphur trioxide causes a lowering of the melting point. This result is confirmed by conductivity measurements, the maximum melting point corresponding with the minimum electrical conductivity. It was found possible to determine the molecular weight of various organic substances, methyl sulphate, trinitrobenzene, phthalic anhydride, &c., in pure sulphuric acid, and from the mean results of nine substances by the application of van 't Hoff's formula a latent heat of fusion of 22·94 calories was deduced. The latent heat of fusion, directly determined, was found to be 22·82.

WE have received from Messrs. Philip Harris and Co., Ltd., Birmingham, a copy of their latest price list of chemical apparatus and chemicals. A special feature of this list is the arrangement into sections, which is likely greatly to facilitate its use. The earlier sections deal with general apparatus, such as instruments for weighing and measuring, apparatus of glass, porcelain, and metal; thermometers, microscopes, spectroscopes, &c.; each of the later sections deals with apparatus used in a special branch of chemistry, for example, brewing, iron and steel analysis, mining, cements, oils, fats and waxes, water and agricultural analysis. Sections are also devoted to physicochemical work, and to driving, stirring, and shaking apparatus. The list is admirably printed and illustrated, and is furnished with a very complete index.

A SERIES of striking addresses delivered on the occasion of the inauguration of Dr. W. A. Noyes as professor of chemistry at the University of Illinois has been printed in *Science* (vol. xxvi., No. 673, pp. 689–714). Prof. H. A. Webber, in discussing the relation of chemistry to agriculture, emphasised in particular the great improvement both in quantity and quality of agricultural crops owing to the utilisation of the results of modern science. Dr. McMurtrie, speaking on the relation of chemistry to the industries, dealt with the need of developing the power and judgment of the industrial chemist by research work carried out in university laboratories; the fact that scientific research is a nation's "greatest financial asset" was especially emphasised. Prof. J. Stieglitz, while deploring the lack of active investigators in the past among teachers in American universities, pointed out that recently there has been a great development in all branches of research, especially since Clark University and the University of Chicago were founded mainly with this object in view. The American teacher is, however, still as a rule overburdened with an excessive amount of routine work, consisting of lecturing, laboratory instruction, and administrative duties, and is seldom afforded aid by the provision of suitable research assistants; funds also are too often lacking. Prof. G. B. Frankforter, in discussing the teaching of chemistry in State universities, pointed to the wonderful growth of German chemical industry as a specimen of what can be done by hearty cooperation between the universities and the leaders of industry of a nation. Chemistry has too often been taught in such a way as to convey the idea that it "serves no other purpose than to be simply dabbled with in college laboratories"; it is not therefore to be wondered at that few realise that its "laws and principles are the foundation stones of our great industrial structures." In his speech on the contribution of chemistry to modern life, Prof. Noyes took as his keynote the supreme importance of purely scientific work undertaken without reference to its technical application; he illustrated his subject by referring to the history of the coal-tar colours and the development of several industries from a purely scientific nucleus. The speeches, taken collectively, constitute a powerful plea for greater support and sympathy being accorded to purely scientific work.

THE second edition, revised and enlarged, of "A Bibliography of the Works of Sir Isaac Newton, together with a List of Books illustrating his Works, and Notes," by Mr. G. J. Gray, will be published this month by Messrs. Bowes and Bowes, Cambridge.

MESSRS. GEORGE PHILIP AND SON, LTD., have sent us two specimen sheets of their "Imperial" series of maps. The price of each sheet is 2*s*. 6*d*., but the maps can also be obtained on cloth, with rollers and varnished, at 3*s*. 6*d*. each. Each sheet is about 28 inches by 19 inches, and contains several physical maps. One sheet provides a map of the world in hemispheres, showing physical features in the familiar shades of green, brown, and blue, together with three maps of the world indicating isobars, rainfall,

and regional vegetation respectively. The other sheet includes maps of the polar regions on a scale of 1 : 35,000,000, and three isothermal maps of the world.

WE have received two volumes of the "Agricultural Statistics of India" for the years 1901–2 to 1905–6. The statistics have been compiled in the office of the Director-General of Commercial Intelligence for the Department of Revenue and Agriculture of the Government of India. The first volume deals with British India, and the second with native States. The total area of India is given as 1,133,977,169 acres (1,771,839 square miles), and the total area of the British provinces is 744,907,040 acres (1,163,605 square miles). From a prefatory note to vol. i. the actual area of British India for which statistics are prepared appears to be 557,236,906 acres (870,683 square miles). Less than two-thirds of this area is available for cultivation; 67,976,325 acres are under forests, and land absolutely barren or unculturable, or covered by buildings, water, and roads, and so on, amounts to 135,329,173 acres. The balance represents the area available for cultivation, of which 207,683,741 acres were actually cropped during the year. Detailed information is supplied in the volumes as to the kind of crops and extent of each, the live-stock, revenue, and transfers of land. Full particulars as to the production of tea and coffee are also supplied. The table dealing with the estimated number of acres on which indigo is cultivated, and the yield in hundredweights, reveals the interesting fact that there was a revival in the indigo industry during 1906–7. The number of acres under cultivation and the yield both show a decided increase over 1905–6, and the yield an increase over that of 1904–5, but both sets of numbers still show a great falling off when compared with 1903–4.

## OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY :—

Jan. 2–3. Epoch of January meteors (Radiant 230°+53°).
3. 1h. 51m. to 6h. 42m. Transit of Jupiter's Satellite IV. (Callisto).
,, Total eclipse of the Sun, invisible in England.
4. 17h. Neptune in opposition to the Sun.
5. 8h. 20m. Venus in conjunction with Moon. Venus 0° 45′ N.
15. 3h. 32m. to 7h. 14m. Transit of Jupiter's Satellite III. (Ganymede).
17. 4h. 19m. to 4h. 34m. Moon occults δ Geminorum.
19. 2h. 57m. Jupiter in conjunction with Moon. Jupiter 1° 33′ S.
,, 11h. 56m. Minimum of Algol (β Persei).
22. 6h. 48m. to 10h. 31m. Transit of Jupiter's Satellite III. (Ganymede).
,, 8h. 45m. Minimum of Algol (β Persei).
25. 5h. 34m. Minimum of Algol (β Persei).
29. 9h. Opposition of Jupiter to the Sun.
,, 10h. 4m. to 13h. 46m. Transit of Jupiter's Satellite III. (Ganymede).

DANIEL'S COMET, 1907*d*.—In No. 4223 of the *Astronomische Nachrichten* (p. 375, December 20, 1907) Herr Kritzinger publishes a continuation of his ephemeris for comet 1907*d*, extending from January 1 to March 5. From this we see that the comet is now apparently travelling, very slowly and in a direction nearly due east, through the constellation Libra. On January 1 its position was α=14h. 47m., δ=−9° 14′, and its computed magnitude was 9·9. On February 1 the position will be α=15h. 8m., δ=−9° 0′, and its magnitude 10·2. Thus, on the latter date, the comet will be very near to the star β Libræ, and during the present month it will rise some five hours before sunrise.

EPHEMERIS FOR ENCKE'S COMET.—According to elements published in No. 4222 of the *Astronomische Nachrichten*, as an abstract from the *Bulletin de l'Académie des Sciences de St. Petersbourg*, 1907, Encke's comet should arrive at perihelion on February 22. An ephemeris, calculated by M. Kamensky and Frl. Korolikov, is given for the period January 3 to April 30. On the former date the comet's position will be α (app.)=23h. 1m. 30s., δ (app.) 1° 45′·7; after that it will apparently move in a north-easterly direction through the constellation Pisces in a line nearly parallel to the stars γ, ι, and ω Piscium, being very near to ι on February 4.

ABSOLUTE SCALE OF PHOTOGRAPHIC MAGNITUDES.—The November (1907) number of the *Astrophysical Journal* (No. 4, vol. xxvi., p. 244) contains a description of a method devised by Messrs. J. A. Parkhurst and F. C. Jordan for the absolute photographic magnitudes of stars. An ingeniously constructed sensitometer box is employed for illuminating certain areas of a photographic plate simultaneously by lights differing in intensity by a known ratio. Plates thus prepared were measured for the opacity of the different areas by means of a Hartmann "mikrophotometer," which was also used to measure the opacity of the extra-focal star images. A comparison of the results obtained for the Pleiades stars with those published by Schwarzschild proved satisfactory, and indicated that within narrow limits the scale obtained was correct. It also showed that the method is capable of yielding results of extreme accuracy over a range of about two magnitudes on a single plate; that it should prove useful for determining the light curves of Algol-type and short-period variables is shown by some results given in the paper.

ANNUAL ASTRONOMICAL PUBLICATIONS.—The *Annuaire* for the year 1908, published by the Bureau des Longitudes, is of the usual form, and, in addition to its numerous invaluable astronomical tables, occupying 400 pages, it contains some 360 pages of chemical and physical data. Of the six appendices, dealing with astronomical subjects, we would direct our readers' particular attention to two, the first by M. Bigourdan on "Les Distances des Astres," the second by M. E. Guyou describing "L'École d'Astronomie pratique de l'Observatoire de Montsouris."

The *Companion to the Observatory* is practically of the same form as in previous years. The increase in the number of known variable stars renders it impossible to add all the new ones to the list, year by year, so it has been decided to reduce the number of ephemerides given, subsequently adding to them if it proves desirable. Complete lists of the Algol variables are given, but only a selected few of the ephemerides. The "inferred" magnetic elements for 1908 (Greenwich) are :—dec., 15° 55′ W.; horizontal force, 0·1854 (C.G.S.); dip, 66° 55′.

Mr. Arthur Mee's card calendar, "The Heavens at a Glance, 1908," is of the usual form, and is an extremely useful publication for astronomical observers. It may be obtained from Mr. Mee, Llanishen, Cardiff, price 7*d*. post free.

THE CANYON DIABLO METEORITES.—Part ii., vol. iv., of the Smithsonian Miscellaneous Collections (p. 203, No. 1725) contains an interesting illustrated discussion of the Canyon Diablo meteorites, by Messrs. G. P. Merrill and Wirt Tassin. The former discusses the distribution and physical characters of the "shale balls" found in such large quantities in the vicinity of the canyon in Coconino County, Arizona. These balls are roughly globular in outline, of all weights up to 50 lb., and consist of an exterior coating of hydrated oxide of iron frequently enclosing unoxidised iron centres, or nuclei, the intermediate shell showing a green hydroxide of nickel mingled with oxides of iron. The inspection of a number of these balls and of the ground in which they are found apparently strengthens the theory of the meteoric origin of the crater.

Mr. Tassin deals with the chemical analysis of the "finds," and shows that these "shale balls" differ to some extent in their chemical composition from the ordinary Canyon Diablo iron. They contain appreciable quantities of chlorine, whereas none has been found in the ordinary "iron," and also contain more phosphorus; to the presence of these two elements the increased oxidation of the "shale balls" may be ascribed.

## THE STRESSES IN MASONRY DAMS.

THE memoir[1] referred to at the foot of this column embodies the results of further work, mainly experimental, on the design of masonry dams, and is a continuation of the work of Atcherley and Pearson described in an earlier memoir of the same series.[2] In the latter paper the authors discussed the imperfections of the present theory of masonry dams, in which the normal stress on horizontal sections is assumed to be linear, and nowhere tensile. This leads to the well-known condition of stability, that the centre of pressure on horizontal sections must fall within the middle-third, and the linearity of normal stress involves a parabolic distribution of shearing stress. Atcherley and Pearson criticised the action of engineers in ignoring the shear stress distribution, and in merely considering frictional stability as the criterion of safety as regards horizontal sliding. They demonstrated the existence of tension on some vertical sections of existing dams using the common theory, and showed that the mid-third rule was not followed consistently throughout the design.

In the memoir now under review, the authors point out the conditions for a true beam problem, viz. :—(1) the dimensions of cross-section are small compared with the length and with the radius of curvature; (2) true cross-sections, *i.e.* sections perpendicular to the line of centroids, exist. As these conditions are not rigidly fulfilled in a masonry dam, the authors refuse to accept any results based on a simple beam analysis, and proceed to an endeavour to throw experimental light on the current mid-third theory, which they summarise as follows :—

(1) The dam shall not be subjected to tensile stresses.

(2) This involves the line of resistance lying in the middle-third of horizontal sections.

(3) Condition (2) has meaning solely on the assumption that the normal stresses are linear.

(4) Linearity of normal stress involves the distribution of shearing stress being parabolic.

The case of an infinitely long dam, or a dam of finite length abutting against rigid supports, is considered mathematically. It is assumed to be straight, to have a plane face at any batter, and a flank curved in any manner. Regarding it as a homogeneous isotropic material, the laws of elasticity lead to a differential expression of a stress function V, which function has to fit the boundary conditions of the dam, viz. :—(*a*) on face where shear = 0; normal stress = water pressure; (*b*) on top and flank, where shear = 0; normal stress = 0; (*c*) on base, where the shear and normal stresses have their actual values. It is stated that (*c*) is generally ignored, and its existence prevents a mathematical solution being obtained.

The memoir proceeds :—"The engineer using the middle-third rule, and thus assuming the hypothesis of linear normal stress, has *actually* (the italics are ours) assumed the stresses over the base. Consciously or unconsciously he has asserted that the pressure is linear and the shear parabolic." The engineer has perhaps some excuse for his assumption, as a mathematical difficulty cannot stand in the way of building a dam. In many other cases, say that of a large masonry arch, in the light of purely theoretical considerations, the action of the engineer, usually *conscious* we imagine, may savour a little of fools stepping in where angels fear to tread. In saying this, we would in no sense wish to convey the impression that the authors hold engineers responsible for what they regard as the uncertainty in the design of dams. Indeed, they expressly disclaim any such intention, frankly recognising the difficulties of the problem. Their results are put forward as preliminary only to further investigation, which they suggest might possibly be undertaken by some such body as the Institution of Civil Engineers. Their investigation shows that the boundary conditions are best fitted by a triangular dam, but that the conditions cannot hold for rectangular or trapezoidal sections. To quote from the memoir :—"*Purely* mathematical researches suggest no great hope of real advance in what is notwithstanding an urgent practical problem. It does not seem probable that they would provide any but the roughest approximations to the actual conditions." The method by which engineers escape from the horns of the mathematical dilemma is viewed with some misgivings, and the authors seek, in experimental work, a fold in which both engineers and mathematicians may dwell together in harmony.

### *Experimental Work.*

The object of the work was to determine the actual straining actions in model dams by direct measurement, and, at the suggestion of the late Sir Benjamin Baker, jelly was adopted as the material of the dams. After much experiment suitable cream-white material made of gelatin, glycerin, and colouring matter was obtained. The size of models was as follows :—base, 45 cm.; height, 35 cm.; breadth, 9 cm. to 10 cm.; substratum, 45 cm.; by 9 cm. or 10 cm. deep. Fig. 1 shows a typical model with lines ruled on the face for the distortion measurements. After much trouble in satisfactorily fixing the models to a rigid wooden base, copper gauze was nailed to the wood and heated. The model was then placed on it, and on cooling was bonded securely to the gauze.

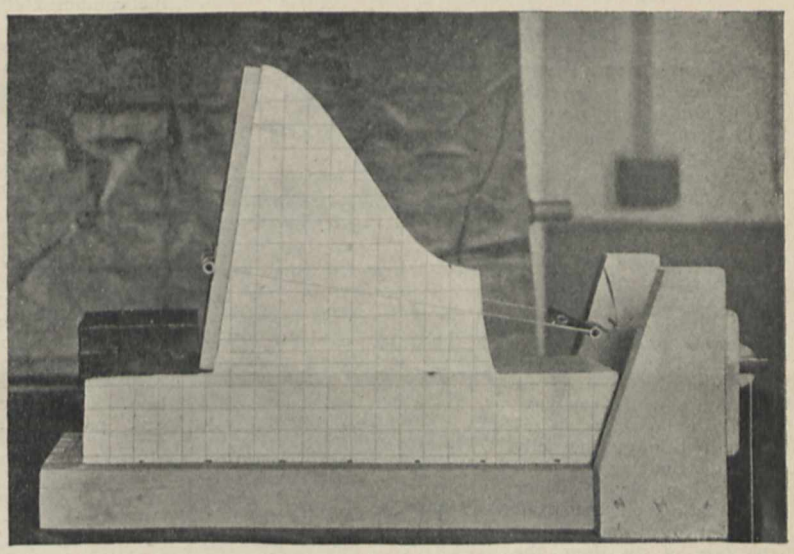


FIG. 1.—Vyrnwy-type dam, moderate water pressure.

Noting the experimental difficulty of attempting to use a dam with rigid, parallel ends, the authors proceed to a mathematical investigation of the stresses in a sheet of elastic material with free sides, *i.e.* a vertical plate with fixed base, no stress on sides, and subjected to a normal stress on part of its edge only. They conclude that with certain limitations there is an identity of stress equations, and that an experimental plate dam without side supports can be used to test the distribution of horizontal shear, by measurement of the distortion of lines ruled on its sides. If the distribution is not parabolic the normal stresses are not linear. The difficulty of measuring the local values of the stretch and squeeze of the jelly prevented any direct estimate of normal stress being obtained, and only the

[1] "An Experimental Study of the Stresses in Masonry Dams." By Karl Pearson, F.R.S., and A. F. Campbell Pollard, assisted by C. W. Wheen and L. F. Richardson. Drapers' Company Research Memoirs. Technical Series v. Price 7*s*.

[2] "On Some Disregarded Points in the Stability of Masonry Dams." By L. W. Atcherley and Karl Pearson, F.R.S. Pp. 44+plates. (London: Dulau and Co., 1907.) Price 3*s*. 6*d*.

existence of tension in the substratum and the manner of final rupture were noted.

Experiments were made on five models :—

(*a*) Water gelatin model, Vyrnwy type, tested to rupture, and illustrating preliminary difficulties.

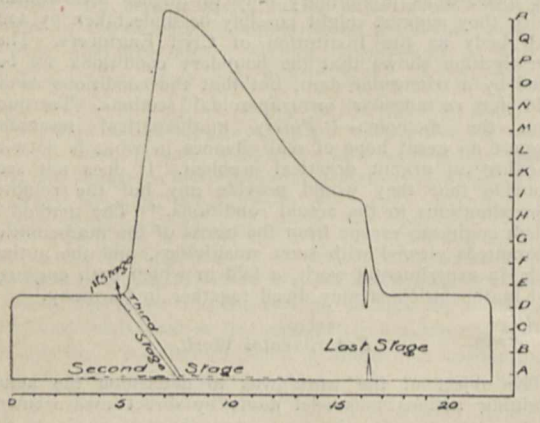



FIG. 2.—Rupture history of a large jelly-dam of the Vyrnwy type.

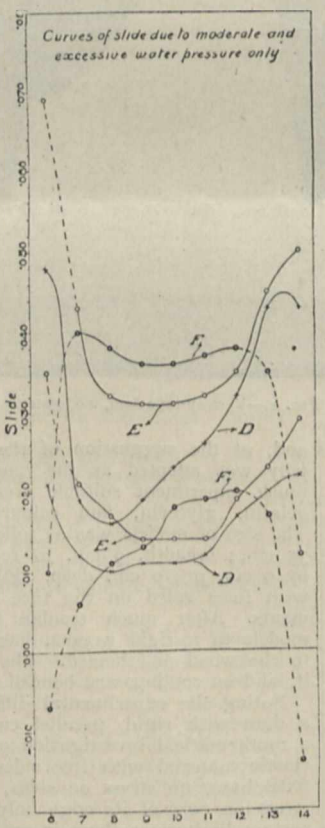
(*b*) Control dam, Vyrnwy type, very stiff jelly.

(*c*) Dam of Vyrnwy type, moderately stiff jelly.

(*d*) Dam of Assuan type, moderately stiff jelly.

(*e*) Dam of Assuan type, moderately stiff jelly, tested by optical methods.

The pressure was applied to the face of the models in three ways :—(1) By a board pressing against the face and loaded normally at the centre of pressure by means of a stirrup and shot bucket. A rubber tube was placed between the board and model to distribute the load so as to imitate water pressure (2) By a board as in (1) without tubing, the jelly itself distributing the load. (3) By an elastic water bag resting on the front of substratum and against the face of the dam, the sides of the bag being rigid and independently supported. The last method gives a true distribution on the face and substratum, and obviates the necessity of piling weights on the latter to maintain equilibrium; but the pressure cannot be varied relatively to the density of the dam as in methods (1) and (2), nor can the dam be tested to rupture. The strains were, in fact, only measurable by delicate optical means.




Curves of slide on the horizontal sections D, E, F. – – –

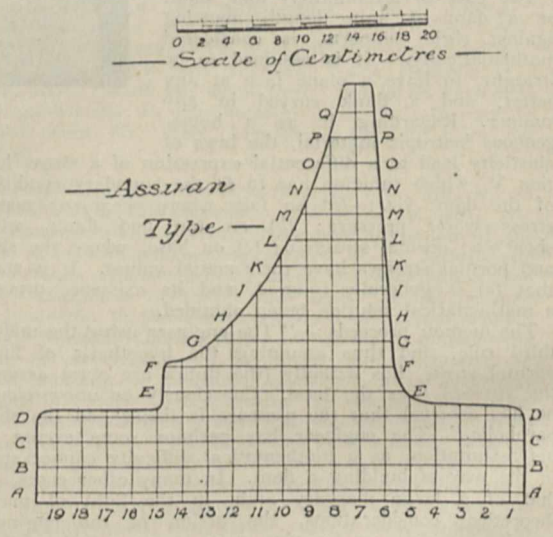
The Vyrnwy model, tested to rupture, behaved as shown in Fig. 2. The initial cracking gradually extended across the entire front, being followed by the tearing of the jelly from the cement or of the cement itself at the base connection. Then followed the third and last stages, the dam finally toppling over the tail, which separated at the vertical cracks. This experiment indicates weakness in the substratum, and tension across vertical sections at the tail. It may be remarked that the failure occurred at the section of discontinuity of contour, where the stresses in any actual dam become distributed through the surrounding earth in an indeterminate manner, and further that the extent to which the connection of such a model to a rigid base (though good experimentally) imitates the bedding of the substratum of an actual dam is also unknown. The existence of tension on vertical sections is emphasised by the authors.

*Distribution of Shear.*

This was determined by measuring the angular displacement of lines ruled on the ends of the models. It is admitted that no great exactitude is possible, and the following sources of possible error are indicated :—

(*a*) Inaccuracy of ruling on a jelly face; (*b*) ruling model while resting on its side, giving error especially near the contour; (*c*) distortion due to elastic effect of weight of vertical jelly; (*d*) set due to weight of jelly, or to shrinkage in course of time. The authors think that (*a*) and (*b*), while sensible, are not very large, but that (*d*) is more important, and not easy to determine. If the model is photographed in a vertical position the change of the angles from 90° may not represent the slide due to weight only, since errors (*a*), (*b*), and (*d*) affect the result. Similarly, the combined effect of weight and water pressure cannot be found exactly; but if the model is photographed on the same occasion, with and without water pressure, the errors are largely eliminated, and the change of angle on the two photographs gives the slide due to water pressure alone. The mid-third rule is applied to the cases of reservoir empty and reservoir full. Hence it must apply to the water pressure alone, and the change of angle as measured should give a parabolic curve if the linearity of normal stress holds.

Typical results for the Assuan dam model are shown in Fig. 3 for the sections D, E, and F between verticals 6 and 14. The dotted lines correspond to doubtful measurements near the contour, which, it may be noted, appears to be rather large at section F. There are indications of negative shear near the contours, but the liability to error and uncertainty of measurement must be remembered in any attempt to interpret the curves in this region. There is no resemblance to a parabolic distribution. The curves of shear due to weight, and to weight and pressure combined, shown in the memoir, are extremely wavy in outline, and nothing short of a quartic would in any way represent them between verticals 6 and 14; but bearing in mind the special liability to error in these cases, the curves are not of the same interest as




Key figure to the network on the Assuan model.

FIG. 3.

those shown in Fig. 3. Similar results are shown for the Vyrnwy type dam.

As a result of the first set of tests, the authors maintain that, allowing for all irregularity in measurement and material, there is no approach to linearity of normal stress up at least two-thirds, and probably up the whole height of dams of current form. The mid-third rule is, therefore, considered valueless as a stability test, and the success of engineers in building stable dams is attributed more to experience in choice of contours, and in the use of a large factor of safety than to any validity in the method of design. The complexity of the problem and the variations of shear distribution led the authors to make a second series of experiments, using many experimental refinements. The general results were of the same character, and an interesting set of curves is presented showing the actual stresses in the Assuan dam as calculated from the more refined measurements on the model. These curves, like the preceding set, are rather irregular, and it is difficult to believe that they can represent the variations of stress in a body having any approach to homogeneity.

Before concluding the memoir with some attempts at semi-empirical determination of stresses, the following processes are suggested for dealing practically with any proposed design :—

"(1) Form a glycerin-gelatin white pigmented jelly dam of the given contour. Determine the form and fixing of the substratum to represent as closely as may be feasible the local conditions. Rule the surface.

"(2) Apply water pressure and determine by the methods indicated above, using either a direct or optical micro-goniometer, the shear distributions. Ascertain the forms of the horizontal and vertical section shear curves.

"(3) Thence by integration—of course mechanical—find the distribution of normal stress along one or two base sections. From these deduce the stretches and squeezes, and take as definite conditions of stability that the maximum stretch and squeeze shall be less than certain values which may be effectively fixed by experiment."

The authors then say that, with such a test, dams like the Vyrnwy and Assuan are found to be theoretically stable, whereas the mid-third rule gives only an apparent theoretical stability.

We are grateful to the authors for their presentation of the interesting results of such difficult experiments, and hope that their work may bear fruit. Their results must stimulate discussion of a highly important subject; but we imagine that the day is not yet when the civil engineer will proceed to the design of a masonry dam, as the authors suggest, by "forming a glycerin-gelatin white pigmented jelly of the given contour, and determining the form and fixing of the substratum so as to represent as closely as may be feasible the local conditions." Here, it seems to us, there are added to the uncertainties of actual conditions, a set of experimental processes liable to error at many points. He will probably prefer to base a new project on the designs of existing dams, modified as these may be from time to time in the light of new ideas, and perhaps by suggestions coming from work of the character of that under review. E. BROWN.

## THE ETHNOLOGY OF AFRICA.

THE communication by Dr. F. C. Shrubsall—"Notes on some Bushman Crania and Bones from the South African Museum, Cape Town"—issued as part v., vol. v., of "Annals of the South African Museum," in continuation of a paper by the same author in the Journal of the Royal Anthropological Institute for 1897, is an important contribution to the ethnology of that region. Incidentally, it marks a reaction against established methods in anthropometry, which, particularly in the case of mixed races, are now treated with well-merited suspicion. In place of an induction founded upon a single "index" derived from the study of the relative magnitude of one skull dimension in terms per cent. of some other dimension, the present paper is based on no less than eighteen factors, and the figures have been subjected to statistical investigation on the most modern lines.

The inquiry starts from a series, unfortunately limited in numbers, of skulls of the race known as the Strandloopers found in caves along the south-eastern seaboard. These constitute a group more pure than that of the Bushmen, and apparently quite distinct from that of the Hottentots. The up-country Bushmen are intermediate between the Strandloopers and the Hottentots. The latter, again, present dimensions between the up-country Bushmen and the Bantu, and in many characters they approach the Negroes of British Central Africa more closely than the Kafir tribes of the east coast. The Central African Pigmies are by their prognathism clearly removed from the Bushmen, and those of the forest zone seem to be largely mixed with the Negro strain. Thus the purest dwarf race is, or was recently, located on the coast at the extreme south of the continent, the furthest point to which, under pressure, they could retreat.

Eastern and part of south-western Africa are occupied by distinct races of Bantu speech, between whom, in character as well as in position, the Hottentots seem to be intermediate. Quite distinct from these races already mentioned are the Somalis and Gallas, of whose physical character little is known. The Masai further south may be allied to these, but they are quite distinct from the Bantu-speaking Negroes. The West African Bantus, between the Rio del Rey and the Congo, in some respects resemble the eastern tribes of the same stock, in others approximate to the Pigmies.

The race history of South Africa may thus be reconstructed—the first inhabitants were of the Bushman type. Round the great lakes and in the Upper Nile valley the tall Negro tribes were developed, or at least are found in occupation of this region. Pressure from the east drove a large section of these southwards, and these in their turn pressed the Bushmen partly to the extreme southern coast, partly into the forest zone, where they intermingled with their neighbours. Some of the Negroes, again, passed north of the forest tract towards the Atlantic shores, and under pressure of tribes from across the Sahara were in part driven back to the forest, and in part down to the western sea, where in an unsuitable environment their physique deteriorated. Some of these Negroes may have been forced down the Nile valley, taking with them or driving before them any survivors of the northern Bush races, who thus came into contact with Egypt; or, as an alternative, it is not impossible that the range of the Bush peoples may have previously extended much further to the north than is usually supposed.

These conclusions rest, as we have said, on a comparatively small number of skulls. It is to be hoped that a fuller supply of African crania may soon be available by which these interesting speculations may be more adequately tested.

## THE PLACE OF THE LABORATORY IN THE TRAINING OF ENGINEERS.[1]

IT is now generally conceded that the advancement and prosperity of an engineering establishment depend upon the number of well-trained employees it possesses, but much difference of opinion exists as to whether the education given in our engineering colleges is of the kind best fitted to produce the type of man who will be of real value to his firm.

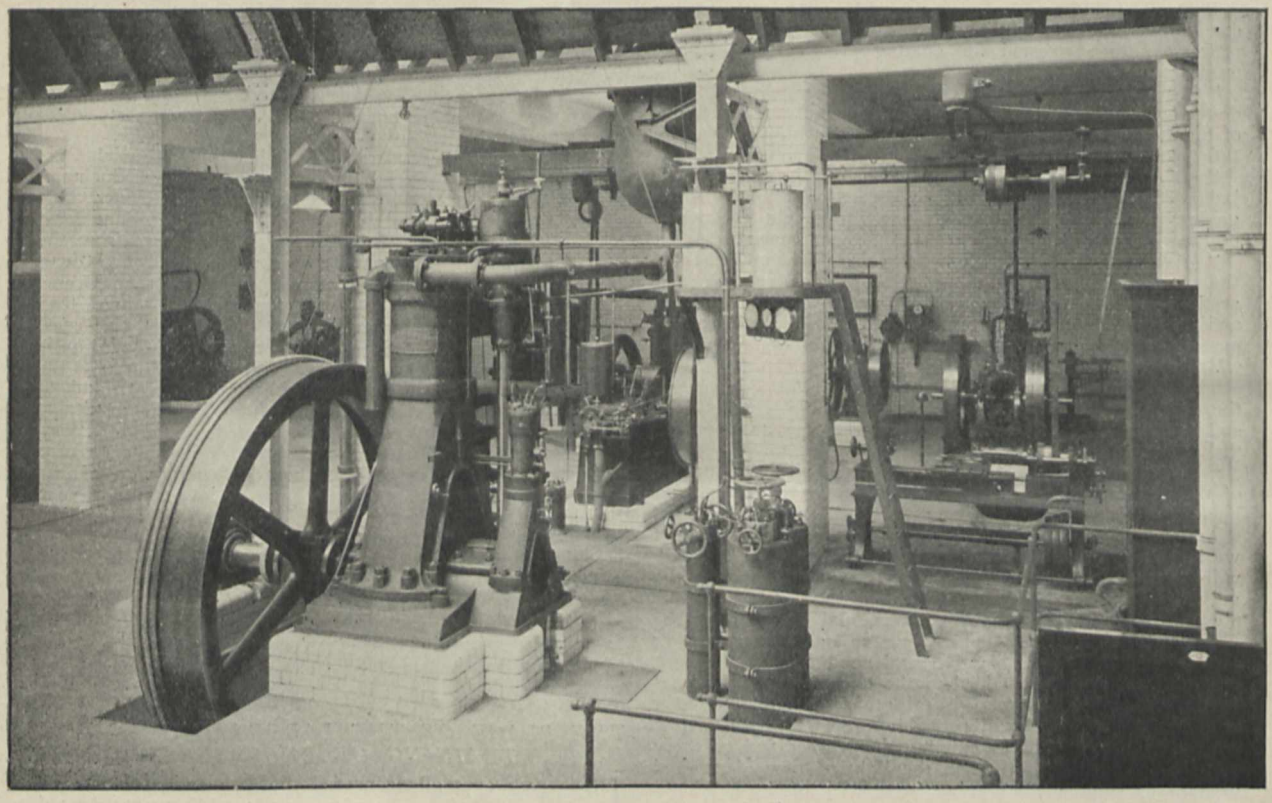
As a rule, at the present day, a boy who intends to become an engineer, on leaving school takes up a three or four years' course at an engineering college. On leaving college he will be found to have a fair theoretical knowledge of engineering, to be capable of making a drawing, of testing specimens of materials, of taking indicator cards, and, generally, of carrying on an ordinary engine or boiler trial. As a rule, however, he is incapable of making much practical use of his scientific knowledge, and if compelled to act on his own responsibility in the case of some mechanical problem often fails badly. Many employers thus look coldly on a system of education which produces such poor results, and we have here an explan-

[1] Based upon a paper read before the Institution of Engineers and Shipbuilders in Scotland, by Prof. A. L. Mellanby.

ation why the chief draughtsman and foreman so often state that they would rather have a boy straight from school than one who has undergone a college training.

To one experienced in both the practical and academic departments of engineering, it is evident that the average college training is unsatisfactory. It has grown up because it created least disturbance to the existing state of things, and the development of this system is chiefly the fault of the employers themselves. Anyone who has read the literature dealing with technical instruction must come to the conclusion that the advance in education has been almost entirely due to the students alone. They have seen the necessity for information concerning the principles of engineering, and have in the past attended college courses with no encouragement from outside sources. At the present day this is fortunately changed, and employers are, on the whole, not unwilling to support a system of education which they see is advantageous to themselves.

The author is of the opinion that our college engineering courses would be vastly improved if it were made



Gas and oil engines. Glasgow and West of Scotland Technical College.

the rule that a considerable amount of workshop practice should precede the final attendance at college. In support of this proposal it may be pointed out that if college training is to produce men who are capable of inventing new processes and improving existing methods of manufacture, then the training must not confine itself altogether to principles, but must direct attention to current engineering work. It therefore follows that the student who wishes to take up his technical studies with profit should not only be prepared with a sufficient knowledge of mathematics and physics, but must also have a working acquaintance with engineering practice. The following plan is suggested as one likely to be the most fruitful.

The student after leaving school should immediately proceed to college, and there take up the first-year general course, whereby he will gain a preliminary grounding in mathematics and science. At the close of the college session he ought to enter an engineering works, where he should remain for at least three years. During these three years he would keep up his studies, especially devoting himself to mathematics and physics. At the end of this time he ought to return to college, and take during the winter the second year's course. The following summer would be again spent in the workshops, and the next winter would be devoted to the third course of college work. Before allowing an apprentice to take up his second year's course at college, it must be seen that he can give evidence of having made material progress in his theoretical knowledge during his three years at the works. The method by which the student would continue his scientific education in this period must of necessity depend upon the employer. Attendance at evening classes would produce least disturbance in the works, and there is no doubt that a hard-working student could get a fair amount of knowledge in this manner. The other alternative is that the apprentices be allowed to attend day classes for, say, two afternoons per week—a system already being tried by several firms.

The advantages of such a system are obvious. The student would take up his second and third years' college work with such a preliminary practical and theoretical training that the whole character of present-day college classes could be changed. The elementary descriptive lectures, so necessary to schoolboys, could be omitted, and in their place lectures of vital importance to every-day engineering practice could be given, and the most recent developments could be described and discussed. The laboratories, instead of being places for elementary testing, might develop into schools for real research. Practical problems that had arisen during workshop experience might be settled by direct experiment, and an amount of information gathered that would in a short time lead to an immense improvement in our national engineering. It appears to be almost universally believed that inventions are the outcome of sudden inspiration to men of genius, and, like poetic effusions, are independent of environment and experience. Such an idea is far from the truth, for most great discoveries have only been evolved after the

closest research, and then by men who have had a training of such a kind that their critical faculties are strongly developed. It cannot be too strongly impressed upon employers how much more valuable an apprentice would be were he to have an opportunity of continuing his mental training in the laboratories of our well-equipped colleges after having first been impressed with the real problems of his calling by some years in engineering works.

The plan suggested above can only be carried out with the help of the employer. His works may at first suffer some disorganisation, but he must see that this is a national problem, and that plan of training can only be the best which results from cooperation with the engineering colleges, even although such a system involves some personal sacrifice.

There must be something radically wrong with a system of apprentice education which appears to be quickly bringing British engineers to the position of manufacturers, under license, of foreign inventions. It is quite evident that by allowing a student to undergo considerable workshop experience before attending his final college course the trained engineer of moderate ability would be a sounder man, while the clever man would have an opportunity of exploiting his capacity for research work. It must, however, be insisted upon that the proper education of our young engineers depends altogether upon the attitude of the employers towards it. If they do not realise the national significance of such higher scientific training as is here contemplated, it is useless for the heads of our colleges to devote attention to schemes of study capable of promoting it.

In designing the laboratories of the Glasgow and West of Scotland Technical College, provision has been made for the comparatively large number of older students attending the final courses in engineering by putting in a number of machines adapted for research work. The illustration shows one corner of the laboratory devoted to motive-power engineering.

## *AMERICAN INVESTIGATIONS ON ELECTROLYTIC CONDUCTIVITY.*[1]

THE two monographs here noticed owe their existence principally to the means placed at the disposal of American workers by the Carnegie Institution of Washington. Without such aid these extensive systematic researches could scarcely have been undertaken, and their publication, unless in abbreviated form, would have presented considerable difficulties.

The report by Prof. Noyes on the work of himself and his collaborators is of the utmost value to all those who are interested in problems connected with the conductivity of aqueous solutions, salt-hydrolysis, and the like. The main object of the research was to obtain accurate values for the electrical conductivity of solutions in a range of temperature from 0° to 300°, and the chief difficulty experienced was in the construction of a conductivity vessel which should be at once capable of resisting the high vapour pressure of solutions up to the critical point of water, and of yielding only traces of conducting impurity to the aqueous solutions it contained. By three years of patient labour Prof. Noyes and Dr. Coolidge succeeded in constructing a platinum-lined bomb with insulated electrodes, which even at high temperatures and with salt-solutions as dilute as 0·0005 normal gives conductivity measurements accurate within 0·2 per cent. With this apparatus the conductivities of typical substances were measured, the results obtained being given and discussed in detail in the report. The substances embraced in the investigation are the chlorides of sodium, potassium, and ammonium, the nitrates of silver and barium, the sulphates of potassium and magnesium, the acetates of sodium and ammonium, the hydroxides of barium, sodium, and ammonium, and, finally, hydrochloric, sulphuric, nitric, phosphoric, and acetic acids. In order to obtain data for calculating the ionisation constant of water, the conductivities of diketotetrahydrothiazole and its ammonium salt were also measured. The value of this constant as so determined agrees well with that obtained by Kohlrausch from the conductivity of pure water. Two special sections deal with the solubility of silver chloride, bromide, and thiocyanate at 100°, and with the transport numbers of nitric acid. From the last section it appears that the ratio of the velocity of the anions to that of the hydrogen ion is several per cent. larger at very small concentrations than at moderate concentrations, and not constant for all solutions more dilute than 0·05 normal, as is usually assumed.

Prof. Jones, of the Johns Hopkins University, has for a considerable number of years busied himself with the study of solutions, especially from the standpoint of the so-called hydrate theory, which in its present aspect differs greatly from the theory which went under that name some fifteen or twenty years ago. In this communication Prof. Jones and his co-workers give the results of their investigation of the conductivity and viscosity of certain electrolytes in water, methyl alcohol, ethyl alcohol, acetone, and in binary mixtures of these solvents. The connection between the fluidity of a conducting solution and the value of its electric conductivity has long been recognised, but comparatively little detailed experimental work has been done on the subject, so that the present research, which shows the close parallelism between the two properties, not only for aqueous, but for other solutions, is of much interest and value. The problem of the variation of conductivity with change of composition of the solvent is extremely complex, but the authors may be said to have laid a safe foundation for the theoretical treatment of the subject.

[1] "The Electrical Conductivity of Aqueous Solutions." By Arthur A. Noyes. Pp. vi+382. (Washington: Carnegie Institution, 1907.)
"Conductivity and Viscosity in Mixed Solvents." By Harry C. Jones. Pp. v+235. (Washington: Carnegie Institution, 1907.)

## *THE TUBERCULIN TEST FOR CATTLE.*

THE unsatisfactory nature of the tuberculin test for cattle is emphasised in two articles published in the "Live Stock Journal Almanac" for 1908. Mr. Bruce remarks that when an animal reacts there is no indication whether the case is serious or not; that an animal which reacts freely may, when tested a month or two later, fail to do so; that change of place, of companionship, and of diet, the advent of œstrus, or, in fact, anything calculated to excite the animal or upset its digestive system, may render the test abortive.

Mr. Thornton records that testing cows in calf is apt to bring on abortion, and adds that in Germany the test is considered untrustworthy, because of the number of slaughtered animals proved to be tuberculous which have passed the test, and the number in which no tubercle could be found which have been condemned by the test. He concludes, however, with the resignation common among breeders when dealing with such matters:—"The test is naturally upheld by many veterinary surgeons, and there is not much probability of it being discontinued, as members of the profession are generally selected as advisers to the Boards of Agriculture in the colonies and foreign countries," and he might have added in this country also.

With such facts before them, with the knowledge that the disease is not necessarily hereditary, that it is by no means so infectious as has been supposed, and that it is not so largely responsible for the spread of tuberculosis among human beings as we were at one time led to believe, one can hardly blame breeders if they show unwillingness to accept the doubtful blessing of the tuberculin test.

In an article on hybrids, Mr. C. T. Davies complains that the term hybrid is often loosely applied by Mendelians and other experimentalists who have little knowledge of practical breeding, to the offspring of two varieties sprung from the same stock. He points out that "cross-breds" is the term practical breeders use for such produce, while "hybrid" is used to designate the progeny of two distinct species. He expresses the hope that biologists will adopt the ancient form of nomenclature, and so avoid confusion in the minds of those of their readers who are practical men.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—In consequence of the incorporation of University College in the University, certain professors of the college will in future be entitled professors in the University of London, and will enjoy the status of appointed teachers. These include Profs. Trouton (physics), Oliver (botany), Hill (zoology), Starling (physiology), Thane (anatomy), Cushny (pharmacology), and Cormack (mechanical engineering). Sir William Ramsay, K.C.B. (general chemistry), and Prof. Norman Collie (organic chemistry) have been appointed teachers of the University for some years.

The announcement that the governing body of the Imperial College of Science and Technology at South Kensington has decided in principle on the appointment of a principal officer of the college has been received with much interest. The post will be an important one, as the resources of the college are considerable, and great developments are expected during the next few years. It is a curious coincidence that two principal officers should be required at the same time at South Kensington, the one at the University and the other at the Imperial College.

Among the advanced lectures in science to be delivered, in connection with the University, during the first term of this year are the following:—A course of eight lectures on "Grasses: their Structure, Biology, Distribution, and Classification," by Dr. Otto Stapf, at University College, on Mondays, beginning on January 27. Eight lectures on "Intracellular Enzymes," by Dr. H. M. Vernon, at the University Physiological Laboratory, on Tuesdays, beginning on January 14. Eight lectures on "The Chemical Constitution of the Proteins," by Dr. R. H. Aders Plimmer, at University College, on Wednesdays, beginning on January 22. Eight lectures on "The Chemistry of the Fats and Carbohydrates and some other Constituents of the Animal Body," by Dr. S. B. Schryver, at University College, on Fridays, beginning on January 24. Four lectures on "Tissue Respiration," by Dr. T. G. Brodie, F.R.S., at King's College, on Mondays, beginning on January 20. Two lectures on "The Physiology of the Emotions," by Dr. F. W. Mott, F.R.S., at King's College, on Mondays, beginning on February 17. Two lectures on "Degeneration and Regeneration of Nerves," by Prof. W. D. Halliburton, F.R.S., at King's College, on Mondays, beginning on March 2. Eight lectures on "The Physiology of Muscular Work," by Dr. M. S. Pembrey, at Guy's Hospital Medical School, on Thursdays, beginning on January 16. Eight lectures on "Inheritance in its Physiological and Pathological Aspects," by Dr. W. Bulloch, and Messrs. G. P. Mudge, M. Greenwood, and A. Bacot, at the London Hospital Medical College, on Wednesdays, beginning on January 15. Four lectures on "The Circulatory System of Reptiles," by Mr. F. E. Beddard, F.R.S., at University College, on Mondays, beginning on January 20. The reader in meteorology, Dr. W. N. Shaw, F.R.S., will resume his lectures on "Meteorological Organisation and Methods of dealing with Meteorological Observations," at the Royal College of Science, on Monday, January 13.

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BY the death, on December 24, of Lady Pearce, widow of Sir William G. Pearce, Trinity College, Cambridge, becomes entitled to a sum of more than 400,000*l*.

WE learn from *Science* that the National Educational Association of the United States has appointed a representative committee to investigate the entrance requirements to the technical schools of the country, and to consider the question of establishing uniform entrance requirements.

THE annual meeting of the Geographical Association will be held at 3 p.m. on Wednesday, January 8, at University College, Gower Street, W.C. The president, Mr. Douglas W. Freshfield, will give an address, Major C. F. Close will deliver a lecture on map projections, and there will be a lantern exhibition of views of the Rhine Gorge by Mr. B. B. Dickinson.

THE Incorporated Association of Headmasters will hold its annual general meeting on January 9 and 10 at the Guildhall, E.C. The agenda paper is mainly occupied with administrative questions, and we observe that a committee is suggested for considering the medical inspection of pupils attending secondary schools. The University of London and the northern universities are urged to come to terms for the mutual recognition of their matriculation certificates. Mr. E. J. Simpson will move a resolution in favour of the inclusion of a paper on elementary physics amongst the optional papers of the northern matriculation.

AT the winter meeting of the College of Preceptors, lectures will be given on a rational comparative method of teaching geography, by Dr. Herbertson, on January 7 and 8, and the subject of geometry will be dealt with by Mr. J. Harrison, of the Royal College of Science, on January 15. During the course of the meeting there will be several lectures on psychology, personal hygiene, and the use of the voice.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Faraday Society**, December 17, 1907.—Dr. F. Mollwo Perkin, treasurer, in the chair.—A physico-chemical study of the complex copper glycocoll sulphates: J. T. **Barker.** The paper deals with the constitution of the blue solution formed when glycocoll is added to copper sulphate solution. It is probable that the concentration of the cupriions has been lowered by the formation of complex cupriglycocoll kations, and experiments are described to investigate this question.—The discovery of the alkali metals by Davy: the bearing of the discovery upon industry: Dr. F. Mollwo **Perkin.** After a short biographical sketch, the author refers to Davy's early experiments on galvanism, which began in 1800 and culminated in 1807 in the electrolytic decomposition of the fused alkalies, caustic soda, and caustic potash. Davy's experiments are described in detail, and it is shown that the E.M.F. of his battery must have been about 220 volts, and the current he used something under 1 ampere. The subsequent experiments on the decomposition of the alkaline earths, by which calcium, strontium, barium, and magnesium in the form of amalgams were obtained, are then described. The second part of the paper deals, among other matters, with the industrial manufacture by Wöhler in 1827 of potassium, by Ste. Claire Deville in 1854 of sodium, with Watt's suggestions (1851) for electrolysing fused sodium chloride, with Castner's chemical sodium process (1886) and his electrolytic process (1890), Rathenau and Suter's sodium process, Becker's process, and the process of Darling, who electrolysed fused sodium nitrate, using porous partitions.

**Geological Society**, December 18, 1907.—Sir Archibald Geikie, K.C.B., Sec.R.S., president, in the chair.—Some recent discoveries of Palæolithic implements: Sir John **Evans.**—The author refers to some recent discoveries of Palæolithic implements on the southern borders of Bedfordshire and in the north-western part of Hertfordshire. In addition to the discovery of a Palæolithic floor at Caddington brickfield, at between 550 and 590 feet above sea-level, implements have since been found on the surface of the ground at 600 and 760 feet respectively; while a good ovate implement was found in thin, water-laid material, at 651 feet O.D. In Hertfordshire, Palæolithic implements have been found at Great Gaddesdon, at a brickfield about 1½ miles north-east of Hemel Hempstead, and at Bedmond, 2 to 2¾ miles south-east of the last locality. The drifts which cap the hills in north-west Hertfordshire seem to be of very variable origin; and a great part of the material is derived from clay-deposits of Eocene age, but little *remaniés*. It seems to the author that it is safest not to invoke river-action for the formation of the high-level deposits, which extend over a wide area and are in the main argillaceous and not gravelly or sandy in character, but to adopt Mr. Worthington Smith's view that in early times lakes or marshes existed in these implementiferous spots, the borders of which were inhabited by Palæolithic man. The evidence that he has brought forward as to the implements having, in some of the Caddington pits, been manufactured on the spot, most fully corroborates this

view.—A deep channel of Drift at Hitchin (Hertfordshire): W. **Hill.** Evidence is given, from nine borings running along a line slightly west of north from Langley through Hitchin, of the existence of a channel of considerable depth, now filled with Drift, occupying the centre of an old valley in the Chalk-escarpment, which may be called the Hitchin Valley.

PARIS.

**Academy of Sciences,** December 16, 1907.—M. A. Chauveau in the chair.—The action of nitrous acid upon allylamine: Louis **Henry.** The interaction of allylamine hydrochloride and sodium nitrite gives allyl alcohol only. Acetone was looked for, but no trace of any isomer appears to be formed in this reaction.—Report by M. **Bertin** upon a memoir entitled "The Study of the Movements of Water which can be produced in Contact and in the Neighbourhood of a Plane Vertical Wall," by MM. Fortant and Le Besnerais.—Observations of the phenomena of Saturn's ring made with the bent equatorial of 32 cm. aperture at the Observatory of Lyons: J. **Guillaume.**—Laplace's transformation and persistent conjugate systems: D. Th. **Egoroff.**—The theory of matrices: M. **de Séguier.**—Infinitesimal transformations and adjoint functions: N. **Saltykow.**—Differential equations of the third order with fixed critical points: J. **Chazy.**—Flame spectra obtained by the electrical method: G. A. **Hemsalech** and C. de **Watteville.** The present paper deals with an application of a process previously described, and is especially adapted for the examination of salts of the rare earths. The salt is incorporated with either boric acid or a mixture of asbestos and sodium silicate, and the whole placed in the hollow of a carbon rod forming the positive pole of an electric arc, the arc being enclosed in a glass globe. A current of air is led into this vessel, and is then allowed to flow to the burner. Finely divided particles of the salt are thus introduced into the flame of a Bunsen burner, and 1 gram of the salt is sufficient to show the flame spectrum for five hours continuously.—The Audiffren refrigerator: MM. **Audiffren** and **Singrun.** A suitable gas is liquefied in the compressor, and the liquid allowed to evaporate in the refrigerator, the special advantage of the arrangement (a diagram of which is given) being that both the compressor and refrigerator are enclosed in an air-tight vessel, only a single stuffing box carrying the pulley through which the whole is driven communicating with the outside air. The pump is driven by the action of gravity on a heavy piston, and it is impossible for the pressure to rise above a figure fixed by the weight of the piston.—Phosphorescence at low temperatures: Joseph de **Kowalski.** Solutions of nitrates of the rare earths in alcohol become strongly fluorescent at the temperature of liquid air. For the erbium solution the tint is green, greenish-yellow for the samarium solution, and violet for the solution of nitrate of neodymium. Alcoholic solutions of phenanthrene, anthracene, and anthraquinone behave similarly. In all cases the substance was previously exposed to a strong ultra-violet light from a quartz mercury arc lamp.—The formation of ozone by the action of the silent discharge at low temperatures: E. **Briner** and E. **Durand.** At the temperature of liquid air the vapour pressure of liquid ozone is practically zero, and it has been found possible integrally to transform oxygen into ozone. For a given expenditure of electrical energy the maximum yield of ozone was obtained with a pressure of oxygen of 100 mm. of mercury. The authors point out that the dangers of explosion of the liquid ozone are much reduced if care is taken to remove all traces of grease from the ozoniser by washing with chromic acid mixture before use.—The hydrolysis of iron perchloride. The function of hydrochloric acid: G. **Malfitano** and L. **Michel.** The experiments described by the authors appear to be best explained by the hypothesis that the constitution of the colloid is formed at the expense of the products of hydrolysis or of complex ions.—The solubility of graphite in iron: Georges **Charpy.** The results given in this paper form an additional argument for considering that the solubility of graphite in iron decreases regularly with the temperature, and give a value of 1 per cent. as the most probable value for the solubility in pure iron at 1000° C.—An attempt at proving certain relations between the atomic weights of the elements: M. **Delauney.** The values of the atomic weights may be represented in the form $A^2/n$, where A and $n$ are two whole numbers.—The gases occluded in steels: G. **Belloc.** The amounts of gas given off are in close relation with the critical points of iron. The gases consist of carbon dioxide, carbon monoxide, hydrogen and nitrogen, and each gas is characterised by a particular temperature of evolution. The distribution of the gases is very irregular in the different layers of the metal.—The extraction of the gases contained in metals: O. **Boudouard.** It is an extremely difficult matter to extract the whole of the gases contained in iron and steel, a third heating to 1100° C. in a vacuum still yielding some gas. The accidental breakage of a porcelain tube in these experiments showed that iron clearly commences to volatilise in a vacuum at 900° C., this effect being quite marked at 1100° C.—The qualitative examination of ciders for tartaric acid: G. A. **Le Roy.** The method is based on a colour reaction with a solution of resorcinol and sulphuric acid.—Syntheses by means of the mixed organo-metallic derivatives of zinc. The constitution of the β-acetoxyl-ketones: E. E. **Blaise.**—The preparation of the cyanides of methyl and ethyl: M. **Auger.** An aqueous solution of potassium cyanide can be employed with advantage as regards yield in the preparation of the nitriles.—Aromatic alcohols. Some new reactions: R. **Fosse.**—Some new Euphorbiaceæ from central and western Africa collected by M. Auguste Chevalier: M. **Beille.**—Variations in *Papaver Rhoeas*: L. **Blaringhem.**—The existence of a peroxydiastase in dried seeds: **Brocq-Rousseu** and Edmond **Gain.** One or more peroxydiastases have been found to be generally present in a large number of dried seeds examined by the authors. This peroxydiastase does not exist in the seed indefinitely, but depends on the age of the seed.—The action of a magnetic field of high frequency on Penicillium: Pierre **Lesage.** In magnetic fields of high frequency the growth of the mould is accelerated, but this effect is indirect, since it is due, at any rate to a large extent, to the heating of the wires of the solenoid.—The origin of anthocyanine deduced from the observation of some parasitic insects of leaves: Marcel **Mirande.**—The marine migrations of the common trout: A. **Cligny.**—The parasitic castration of male star-fish by a new infusoria, *Orchitophrya stellarum*: Casimir **Cépède.**—The variations of the length of the intestine in the frog: Émile **Yung.**—The action on the heart of certain metallic ions introduced into the organism by electrolysis: Jean **Gautrelet.**—The presence of Schaudinn's treponemes in the appendix of a hereditary syphilitic fœtus: Ch. **Fouquet.**—The possibility of establishing a true diagnosis of death by radiography: Ch. **Vaillant.**—A case of modification of a *thalweg* by the intervention of a volcanic intrusion (Sardinia): M. **Deprat.**

December 23, 1907.—M. A. Chauveau in the chair.—The president announced the deaths of M. Janssen and Lord Kelvin.—Observation of the transit of Mercury across the sun, November 13–14, 1907, at the Observatory of Aosta, Italy: M. **Amann.** Times of the four contacts are given, with remarks on the formation of the black ligament, luminous point, and rings.—The compensation of an electromagnetic compass for armoured blockhouses and for submarines: Louis **Dunoyer.**—Liquid dielectrics: Louis **Malclès.**—The conditions of maximum yield for telephonic apparatus: Henri **Abraham** and M. **Devaux-Charbonnel.** The problem attacked in the present paper is as follows. Accepting the telephonic apparatus at present in use, are the various elements, the transformer, the resistance of the bobbin of the receiver, &c., chosen so as to furnish the maximum effect in the transmission of speech? The theoretical investigation leads to the conclusion that the receiving instruments should have a resistance of 100 to 200 ohms, and the transformation ratio should be near 6 or 7. An examination of the transformers in actual use in telephone work showed an efficiency of only 60 per cent., and with this efficiency the transformers are too small for the work.—The application of the method of limiting densities to organic vapours:

Ph. A. **Guye.** From an examination of the experimental work of Ramsay and Steele on the densities and compressibilities of organic vapours, the author concludes that neither the parabolic extrapolations of Daniel Berthelot nor the graphical extrapolation of measurements of compressibility allows of the rigorous verification of the principle of limited densities.—The influence of temperature on the optical properties of dissolved bodies: C. **Chéneveau.** The index of refraction of a dissolved body varies only slightly with the temperature; the variation of the optical constant or the molecular refractive power of a dissolved substance under the influence of temperature appears to arise more especially from the change of volume of the solution, and appears to be produced in the same sense as the change of temperature.—The detection and estimation of nickel in the presence of any quantities whatever of cobalt, iron, and manganese: Emm. **Pozzi-Escot.** The nickel is precipitated as a double molybdate of nickel and ammonium. No test analyses are given.—The nature of some phosphorescent elements and meta-elements of Sir W. Crookes: G. **Urbain.** Starting with definite mixtures in varying proportions of pure terbium and gadolinium, the author has been able to reproduce many of the phosphorescent spectra attributed by Sir W. Crookes to separate elements.—A new chromium sulphate: Paul **Nicolardot.**—The influence of acids and bases on the fixation of acid and basic colouring matters on wool: L. **Pelet-Jolivet** and N. **Anderson.** Details of the amounts of an acid and a basic dye taken up by wool in presence of varying amounts of hydrochloric, sulphuric, and phosphoric acids are given, and it is claimed that the results are in accord with the hypothesis of contact electrification, and agree with the colloidal theory of dyeing.—Glycidic ethers and aldehydes in the naphthalene series: Georges **Darzens.**—An isomer of sparteine, isosparteine: Charles **Moureu** and Amand **Valeur.** A description of the preparation of the base, its dichlorohydrate, chloroplatinate, hydriodide, and picrate. It forms a bi-tertiary saturated base, and the methyl group is not attached to the nitrogen.—Observations on the formation of the aleurone grains during the ripening of the seed: J. **Beauverie.**—Observations on the production of chlorophyll in the higher plants at different luminous intensities: W. **Lubimenko.** An important fact which appears from this work is that the best illumination for the production of chlorophyll is lower than the maximum luminous intensity of daylight. A green plant can adapt itself to a feeble light by increasing its production of chlorophyll.—The constancy of composition of plant juices obtained by successive extractions: G. **André.**—The action of tyrosinase on some substances resembling tyrosine: Gabriel **Bertrand.** Only those substances examined which contain a phenolic hydroxyl group proved to be oxidisable by a solution of tyrosinase. The length and nature of the lateral chain appeared to have only a secondary influence, provided that the chain was not too strongly acid or basic.—The excito-secretory action of the internal branch of the spinal nerve on the stomach and pancreas: F. X. **Lesbre** and F. **Maignon.** The internal branch of the spinal nerve of the pig contains, not only motive fibres, but also secretory fibres, the centrifugal fibres of the vagus.—Does the radiography of the abdominal organs permit of the diagnosis of true death? M. **Béclère.** Although the radiography of the abdomen is capable of giving assistance in the differential diagnosis of apparent and true death, the results cannot be absolutely relied upon.—The physiological properties of tubercle bacilli which have been submitted to the action of chlorine: MM. **Moussu** and **Goupil.** These chlorinated bacillary products have distinctive toxic properties, easily appreciable in healthy subjects. The thermal reaction provoked differs from that of tuberculin.—Contribution to the study of the influence of traumatisms on the localisation of tuberculosis. Results of articular traumatisms in rabbits tuberculised by the digestive canal: S. **Rodet** and M. **Jeanbrau.**—The Allier in Miocene times. A deposit of Miocene vertebrates near Moulins: Ph. **Glangeaud.**—The fossils near the tile works of Soumailles, in the commune of Pardailhan: G. **Vasseur.**—The Agout, a tributary of the Aude, and the valley of the Lhers mort: J. **Blayac.**—Researches on the variations of the terrestrial potential: Albert **Nodon.**

## DIARY OF SOCIETIES.

*FRIDAY*, JANUARY 3.

GEOLOGISTS' ASSOCIATION, at 8.—On the Zones of the Chalk in the Thames Valley between Goring and Shiplake: C. P. Chatwin and T. H. Withers.

*MONDAY*, JANUARY 6.

ARISTOTELIAN SOCIETY, at 8.—Prof. James's "Pragmatism": G. E Moore.

VICTORIA INSTITUTE, at 4.30.—The Influence of the Glacial Period upon the Early History of Man: Rev. G. F. Wright.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Preparation of Paratoluidine from mixed Toluidines by means of Paratoluidine Hydrate: R. J. Friswell.—The Determination of Small Quantities of Bismuth: H. W. Rowell.

*WEDNESDAY*, JANUARY 8.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Recent Improvements in Electric Conduit Traction Construction: Fitz Roy Roose.

GEOLOGIGAL SOCIETY, at 8.—On the Application of Quantitative Methods to the Study of the Structure and History of Rocks: Dr. H. C. Sorby, F.R.S.—Chronology of the Glacial Period in North America: Prof. G. F. Wright.

*THURSDAY*, JANUARY 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Cost of Electrical Power for Industrial Purposes: J. F. C. Snell.

*FRIDAY*, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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