THURSDAY, APRIL 4, 1912.

MARINE LIFE IN NORTHERN SEAS.

Campagne Arctique de 1907: Duc d'Orléans.
Etude Lithologique de Fonds recueillis dans les Parages de la Nouvelle-Zemble. By Prof. J. Thoulet. Pp. 30+map. (1910.)
Journal de Bord et Physique du Globe. Pp. 101+10 plates+2 maps. (1911.)
Echinodermes. By J. A. Grieg. Pp. vi+40+1 plate+3 maps. (1910.)
Mollusques et Brachiopodes. By Ph. Dautzenberg and H. Fischer. Pp. v+25+map. (1910.)
Faune des Mousses: Tardigrades. By Ferd. Richters. Pp. 20+2 plates. (1911.)
Microplankton des Mers de Barents et de Kara. By Prof. Alph. Meunier. Pp. xviii+355+2 maps; also a volume of xxxvi plates. (1910.)
(Brussels: Charles Bulens, 75 rue Terre-Neuve.)

THE Arctic and Antarctic fauna and flora bid fair to be better known than those of the tropics. Successive expeditions are bringing us back abundant results from both polar regions, and amongst these the Duc d'Orléans's Arctic cruise of 1907 will form a noteworthy contribution to knowledge. The reports are being published in luxurious form by Bulens at Brussels, and the first six volumes of the series are now before us.

This, the second of the Duke's Arctic expeditions, took place in the ship *Belgica,* under the command of Captain A. de Gerlache, and was engaged in exploring the Barents Sea, the Kara Sea, and the Mourman Sea. The physical observations taken on board, including those on the state of the atmosphere, the sky, and the sea, are reported on by M. de Gerlache, who also records the higher animals (mammals and birds) that were observed.

The deposits collected from the bottom of these northern seas are discussed by Prof. J. Thoulet, and they seem to agree with other polar samples in being characterised by the very fine division of the mineral particles and the comparative scarcity of calcareous matter.

Only a few groups of the invertebrate animals from the sea bottom have as yet been reported upon. These include the Echinodermata, discussed by James A. Grieg, evidently a rich collection referred to twenty-five species, none of which, however, are described as new to science. This is not surprising, as, since the Austrian polar expedition under Payer and Weyprecht in 1872–74, the seas traversed by the *Belgica* have been explored by the Dutch *Willem Barents* expedition, the Russian *Yermak,* the successive Swedish expeditions of Nordenskiöld, the Danish *Dijmphna,* the Dutch *Varna,* and the Russian *Zarja*—possibly by others also. Eight of the twenty-five Echinoderm species are known to be circumpolar, and some of the others may prove to be so when we have fuller information as to their distribution to the north of the Pacific Ocean.

The report by MM. Ph. Dautzenberg and H. Fischer deals with thirty-eight species of Mollusca and the two Brachiopods, *Rhynchonella psittacea* and *Waldheimia cranium.* Twenty-seven species of Tardigrada were obtained from collections of mosses made at Novaya Zemblia, at Jan Mayen, Spitsbergen, Greenland, and the Franz-Joseph archipelago. We are told by Dr. Ferd. Richters that the best results were obtained when the mosses were thoroughly dried and sealed up in sterilised bags, from which the Tardigrada and other small game were months afterwards recovered, and revived by the addition of water. The microfauna of these dried mosses was found to contain Tardigrada, Protozoa, Rotifers, Oribatidæ, Oligochæta, Nematodes, and even Copepoda (*Moraria muscicola*). Richters describes for us, from the Tardigrada, two new species of Macrobiotus and three of Diphascon.

By far the most important, however, of these memoirs is that dealing with the Microplankton by Dr. Alph. Meunier, consisting of a large volume of text running to nearly four hundred pages and an atlas of thirty-six beautiful plates crowded with useful figures. This report, and especially perhaps the series of fine plates, will be of the greatest value to all planktologists working on these minute Protista. The groups of pelagic plants and animals dealt with under the convenient term "Microplankton" include Peridiniacea, Diatomacea, Microphyta of coloured snow (such as Diamylon and two new genera, Echinum and Folliculus), Cryptomonadacea, Silicoflagellata, Tintinnidæ, Infusoria, Radiolaria, Foraminifera, and some smaller groups of enigmatical organisms such as Halosphæra and Pterosperma, and quite a number of allied forms, for which no fewer than nine new genera have been created. Altogether twenty-five new genera and a large number of species previously unknown are described and figured in this report. All these planktonic forms, old and new, are the result of twenty-two vertical tow-net hauls and some horizontal ones taken in the Barents and Kara seas.

Dr. Meunier does not always follow the classification and nomenclature of other recent authorities, but whether we can agree with him or not on such points, at least we are grateful for his very beautiful drawings of the forms he is describing. In the Peridiniacea he describes a number of new species belonging to well-known genera, but nothing of a very novel or remarkable nature. A few new genera which are established for species of Peridinium scarcely seem to be sufficiently characterised, and may perhaps be accepted as subgenera.

New forms are added in every group of the Microplankton, but perhaps the most notable additions to knowledge are in "Groupe V—Organismes énigmatiques," where a large number of curiously shaped things are described and figured as being related to Halosphæra, Pterosperma, and their allies, but some of which one cannot help thinking may eventually prove not to be Protista at all, but the eggs and egg-coverings of some of the Metazoa.

The Tintinnidæ and allied Infusoria are very fully treated, and then a few Rhizopoda bring the first part of this report to an end; and the second part—nearly half of the volume—is found to be devoted wholly to Diatomacea. It is almost with a feeling of relief that one finds that not many new forms are added to this already enormous group, and that most of the space is devoted to a discussion of the occurrence and condition of known species, many of them common forms in our own British seas. In a final note to the Microplankton we are promised a supplement in tabular form dealing in detail with the distribution and abundance of the more common species when the remainder of the plankton has been reported on. We look forward with interest to the publication of the remaining volumes.

Altogether this is a notable series, upon the appearance of which the leader of the expedition, his collaborateurs, and the authors of the reports may alike be congratulated.

W. A. Herdman.

LEFT-HANDEDNESS.

Untersuchungen über Linkshändigkeit und die funktionellen Differenzen der Hirnhälften nebst einem Anhang: Ueber Linkshändigkeit in der deutschen Armee. By Dr. Ewald Stier. Pp. iv+352+59. (Jena: Gustav Fischer, 1911.) Price 10 marks.

ONE of the most striking features that serve to distinguish man from all other creatures is his ability to learn to execute skilled movements of a much greater variety, complexity, and precision than are attainable by the rest of his order. But an even more interesting human trait is revealed in the fact that in the vast majority of mankind the right hand and the apparatus which controls its movements are more apt to acquire this skill and to develop its innate potentialities to a much higher degree than the left hand is capable of.

That in a small minority of people this state of affairs is reversed, and the left hand becomes more highly endowed with the inborn aptitude to learn and readiness to perform the more complex and finely adjusted movements, has ever provided food for reflection. For the condition of left-handedness interests not only the student of biology, but also those who concern themselves with educational policy, the devotees of sport, and the "man in the street"; and quite a considerable literature has grown up from the repeated discussions in which this interest has materialised, culminating in this characteristically Teutonic treatise or encyclopædia of all that bears upon the left-handed person, his anatomy, his mental and moral qualities and weaknesses.

It has been assumed as an axiom by almost everyone who has discussed these problems hitherto that the greater skill of the right hand, in the majority of mankind, necessarily implies a superiority of the left cerebral hemisphere, which controls the movements of the right hand—a superiority not only in the mere regulation of skilled motion, which is obvious, but also in its psychical potentialities, which has always seemed to me to be a gratuitous and wholly unjustifiable assumption.

The result of this confusion of ideas has been that most investigators have endeavoured to find some anatomical peculiarity in the left cerebral hemisphere, or some favourable circumstances in the arrangements for its nutrition which would explain this imaginary predominance. But most of such researches have led to a result which their authors regard as utterly enigmatic—that if there is any evidence of superiority of one cerebral hemisphere over the other it is more often the right, and not the left, that excels.

The most instructive illustration of this line of argument is the late Prof. Cunningham's Huxley memorial lecture, delivered in 1902, for he developed it in his usual lucid manner, and frankly admitted that he had reached conclusions precisely the reverse of what he had expected. But though he confessed that he had been baffled, his belief in the existence of the functional superiority of the left cerebrum was not lessened.

In the *British Medical Journal* of August 29, 1908, I protested against the whole assumption involved in this argument that the control of skilled movements of the right arm and the muscles of speech represent the sum total of the higher psychical manifestations of the human intellect. Dr. Stier does not seem to be aware of this criticism, for his treatise may be regarded as a great expansion and elaboration of the theme and the mode of treatment adopted by Prof. Cunningham. Its great value is that it contains a detailed summary of an enormous mass of data (with a full bibliography), including all that relates to left-handedness, asymmetry of the human body and especially of the brain, both as regards structure and function.

Dr. Stier gives the results of an attempt to discover evidence of Mendelian phenomena in the inheritance of left-handedness.

A great deal of curious statistical information is given regarding the frequency of the incidence of left-handedness in men and women, and also in different localities in Germany—sexual and racial distinctions—as well as to the psychology of left-handed persons. Left-handed children are said to be not only slower in learning to read and write, but are much more prone than right-handed children to stigmata of degeneration, as well as to functional disorders.

He protests, not perhaps without considerable justification, against what he calls the fanaticism of ambidextral enthusiasts.

Like many of his predecessors in this field of investigation, Dr. Stier attempts to institute large generalisations concerning the incidence of left-handedness in prehistoric peoples on the evidence of the forms of flint implements, but he does not seem to realise that in the asymmetry of the occipital region of the cranium (as I pointed out in the *Anatomischer Anzeiger* in 1907), more definite and trustworthy personal indications are to be found than any weapons or other handiwork can give.

The book can be recommended as a useful work of reference, provided the reader bears in mind that there is another way of looking at the facts.

G. Elliot Smith.

TECHNICAL CHEMICAL ANALYSIS.

Traité Complet d'Analyse Chimique appliquée aux Essais Industriels By Prof. J. Post and Prof. B. Neumann. Deuxième édition française entièrement refondue. Tome Premier, Quatrième Fascicule. Pp. iv+861–1352. (Paris: A. Hermann et Fils, 1911.) Price 18 frs.

THE most striking novel feature of this new French edition of Post-Neumann's well-known handbook of technical chemical analysis is probably the inclusion in the present volume of a section, covering some 220 pages of text and 30 plates, dealing with the whole subject of Metallography. The inclusion of such a section is typical of the importance which this new science has already attained in France, but it is a little disappointing to find that the section in question is little more than a translation of an elementary text-book of metallography issued by Goerens in German a few years ago.

The text as now printed in French has been considerably extended, and to some extent modified, by the editorship of M. F. Robin—himself one of the most active of the younger French workers in metallographic research—but the whole plan and type of treatment remain the same, and thus retain the inherent defects of the original. One of the more serious of these defects is the almost total neglect of the work done and the results achieved by British workers in this field; in the original German edition French and English workers were almost equally ignored, but the French translator and editor have remedied this as far as French workers are concerned. One consequence of this narrow attitude of mind on the part of the author is that the book in its present form contains many statements which have been shown to be inaccurate.

In the present edition a special feature has been made of the inclusion of "equilibrium diagrams" of as large a number of systems of alloys as possible; a considerable amount of space is therefore taken up by diagrams of this kind, many of which are known to be erroneous, while it is now admitted that the majority of them require substantial modification. The diagrams reproduced in this book have most of them been drawn up by research-students at Göttingen, using rough approximate methods of investigation which Prof. Tammann regarded as adequate for the special purpose which he had in view, viz., the determination of the number of well-defined intermetallic compounds. These methods, however, have been shown to be far too rough and inaccurate for fixing the less obvious portions of these diagrams, so that it is scarcely right to present the reader with many pages filled with these figures without warning of their proximate nature. In some cases, indeed, the diagrams as quoted have long been superseded by better-established results. This applies particularly to those dealing with the alloys of aluminium and copper, and of lead and tin.

A similar criticism might fairly be levelled at the account which is given of the methods of metallographic investigation and of the instruments employed. Thus, no mention is made of the use of the potentiometer for measuring the E.M.F. of a thermo-couple, and while the metallurgical microscopes of Martens-Heyn and Le Chatelier are fully described, equally well-known metallurgical microscopes of British design are not mentioned.

That section of the book dealing with the iron-carbon alloys is, as in the original German edition, far the most satisfactory; the treatment is clear and concise, although here also the latest developments are disregarded. A special word of praise is, however, demanded by the splendid photo-micrographs with which this portion, and indeed the whole of the metallographic section, is illustrated. Both as regards the original photographs and the typographical reproduction, practical perfection has been attained—and, indeed, these photo-micrographs almost deserve the lavish setting of black margins and wide white spaces with which they are adorned.

The remaining portions of this volume, dealing mainly with inorganic acids, follow closely on the lines of the previous edition, and call for little special comment, except as regards the sections dealing with the estimation of carbon in steel. Here the simplest and most trustworthy of the available methods—that of direct combustion in oxygen—has not even been mentioned, while the various risks of error attaching to the other methods described are entirely ignored.

The perusal of the volume as a whole raises the question whether these large compilations really serve any useful purpose; they attain huge dimensions by endeavouring to cover the entire ground of technical chemistry so far as analyses and tests are concerned, and yet the treatment of each subject is limited and is liable to become one-sided and inadequate. It would seem that with the huge dimensions now attained by the various branches of the subject, the day of the general handbook has passed, and the era of the special monograph has dawned.

A HANDBOOK OF PHOTOTELEGRAPHY.

Handbuch der Phototelegraphie und Telautographie. By Profs. Arthur Korn and Bruno Glatzel. Pp. xvi+488. (Leipzig: Otto Nemnich, 1911.) Price 28 marks.

THIS is a book which, by reason of its thoroughness and its exhaustive treatment of matters which bear upon the main subject, must be recognised as the standard work of reference on phototelegraphy for a long time to come. Such an immense amount of work has been done in this branch of telegraphy that the book must be regarded to a great extent as historical, for even Prof. Korn himself quickly rendered his own selenium apparatus obsolete by the rapid improvements effected in his telautograph.

The first chemical telegraph of Alexander Bain came really before its time, as although a suitable system has been based upon it for the transmission of half-tone photographs, half-tone photographs did not exist in 1843, when Bain started his experiments. Much of the apparatus for telegraphing pictures and photographs is, in fact, seen from Prof. Korn's work to have been the practical outcome of extensive experiments made originally for the purposes of ordinary word telegraphy.

The book is rendered of the highest possible practical value on account of the large number of diagrams and illustrations, particularly those relating to constructional points, and those who are to any extent conversant with the practical difficulties of picture-telegraphy may perhaps wish that still more space had been reserved for the discussion of the modern apparatus.

Perhaps the most interesting portion of the book is that relating to Prof. Korn's apparatus for transmission by means of selenium. This element is undoubtedly destined to find further uses in physical measurements, and the excellent work done by the authors in overcoming the inertia of selenium under the influence of light should prove of considerable value. The short chapter on photo-electric cells will, it is to be hoped, be made much fuller in a future edition in view of their important application to astronomical measurements; some data as to the constants of the cells prepared by Elster and Geitel would have been welcomed by many readers.

As will be seen from the reproductions of results obtained with Prof. Korn's telautograph, the amount of detail that can be obtained in a telegraphed picture is quite remarkable; the transmitter comprises a metal drum revolving under a stylus, the picture being drawn (or photographed in line) in insulating ink; this effects the interruptions of the current flowing through the telegraph lines, which are recorded by a special type of Einthoven galvanometer, the metal "string" of which is shifted on the passage through it of a weak current, the shift allowing a narrow beam of light to pass to the exposing box, where a synchronously revolving drum furnished with photographic paper is placed.

The systems or adaptations of Charbonelle, Berjeanneau, Belin, Thorne-Baker, and others are described, though the reader is not given an opportunity to compare their results with those obtained by the authors, and brief reference is made to the wireless experiments that have been carried out.

The book is thoroughly up to date, including references even to the new system of Prof. Tschörner, of Vienna, and will be found extremely interesting by the many people who are at the present time experimenting in the directions discussed.

T. T. B.

THE MEASUREMENT OF REFRACTION.

Refraktometrisches Hilfsbuch. By Prof. W. A. Roth and Dr. F. Eisenlohr. Pp. viii+146. (Leipzig: Veit and Co., 1911.) Price 6 marks.

A MEASUREMENT of the refractive power of a liquid, while of considerable practical value for identifying the liquid or for ascertaining its freedom from impurities, is of far greater importance from the purely scientific point of view. Investigation has shown that for each substance a relation subsists between the refractive index and the density that is independent of the temperature; and, further, that the specific refractive index, as this relation is termed, may be calculated when the molecular constitution is known. Various formulæ have been suggested for the specific refractive index. Thus Gladstone and Dale on empirical grounds proposed $\frac{n-1}{d}$; while a more accurate expression $\frac{n^2-1}{n^2+2} \cdot \frac{1}{d}$ was afterwards put forward simultaneously from theoretical considerations by two men of nearly the same name, Lorenz in Copenhagen and Lorentz in Leyden.

The little book which Prof. Roth and Dr. Eisenlohr have prepared will prove invaluable to investigators in the subject, and, in fact, to all who have need to measure the refractive indices of liquids with the highest possible degree of accuracy. They fully describe the various forms of refractometer in use for the purpose and the methods of using them, and state the corrections necessary when the temperature of the observations differs appreciably from the standard, and give in tables the indices corresponding to the divisions in instruments with arbitrary scales. The old method of determining the deviation of a beam of light passing through the liquid contained in a hollow glass prism has entirely given way to the more convenient and more accurate method based upon the principle of total-reflexion. They describe further with equal fulness the method of finding the density by means of a pyrometer, point out the corrections required by the expansion of the glass, and give tables to facilitate their application. Towards the end of the book the authors show by a few examples how closely the observed value of the molecular refractive index agrees with that deduced from the constitution, and discuss the meaning of the sensible differences that occur in certain groups of substances. The book closes with some useful tables, and a small book of five-figure logarithms is enclosed in a pocket within the cover.

OUR BOOKSHELF.

The Modern Locomotive. By C. Edgar Allen. Pp. ix+175. (Cambridge: The University Press, 1912.) Price 1*s.* net.

THIS volume belongs to the series of Cambridge Manuals of Science and Literature, and taken as a whole the information given in it is up to date and described in terms clearly evident to the lay reader.

As the boiler is "the heart and soul" of a locomotive, the author deals with it in chapter i. He claims that the multitubular boiler as fitted to the "Rocket" originated with Mr. Booth, the secretary of the Liverpool and Manchester Railway—an unwarrantable claim, and one made for the first time, so far as the present reviewer's knowledge of locomotive history goes. The "Rocket's" multitubular boiler was to the designs of William Henry James, son of William James—the father of railways. In an agreement dated September 1, 1821, W. H. James's patent was assigned to Messrs. G. Stephenson and Wm. Lush on certain terms, and it was with this boiler the prize of 500*l.* was won at Liverpool in 1827 by the "Rocket."

The chapter is interesting; it illustrates how old ideas are resuscitated even in locomotive engineering; for instance, the spark arrestor, so called, illustrated in Fig. 9, and the variable blast pipe in Fig. 10, were both in use on the Manchester, Sheffield, and Lincolnshire Railway, now the Great Central Railway, in the year 1878. The question of a satisfactory spark arrestor is a prominent one at the present time, and many experiments are in progress: a combination of Louvre plates on the smoke box and an ash-ejecting arrangement on the blast pipe is now giving satisfactory results. Chapter iii. is devoted to modifications and improvements in the standard boiler.

The volume will be found to contain much interesting and useful information. It should be of much use to those of the general public who take an intelligent and intense interest in the locomotive. To the apprentice in the works the information should be of particular value.

N. J. L.

The Gardener and the Cook. By Lucy H. Yates. Pp. x+260. (London: Constable & Co., Ltd., 1912.) Price 3*s.* 6*d.*

THIS little book is attractive in more ways than one. It stimulates the imagination as to what can be done both in garden and kitchen, more especially in the kitchen. It leaves, however, a little sediment of despair in the mind, after all, for where out of France are "Charlottes" to be found? So much depends upon "Charlotte," the cook.

What use is a kitchen-garden, however successful, if you have a stupid, obdurate "Charlotte," who will not see that to be a real cook is to have a talent for taking pains, and that to be careful and wise is not to be mean? Who can persuade our English cooks that cooking is an art, and requires interest, care, and work, and some imagination, and not a thing to be undertaken only to be done with as soon as possible?

Would these women who are clamouring for the "right" to do work for which they are obviously unfitted turn their superfluous energies to training themselves and then training our "Charlottes" in the knowledge of the delights of the combination of thrift and dainty dishes, of which this book gives so fascinating and practical an account, then indeed would their now wasted energies have some real and useful result. There is no more needed reformation than that of work in our kitchens. To anyone with a conscience and some little knowledge, the wastes and missed opportunities, even in the simplest kitchen, are appalling.

This book should be a help to many a young housekeeper towards bettering things in her own home and perhaps inspiring a young "Charlotte" to realise the beauty and importance of her work, and to lead her on also to realise the importance of small things in the kitchen.

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.*]

Acquired Characters and Stimuli.

I THANK Sir Ray Lankester for the complimentary expression with which he begins his letter (NATURE, March 21) and for the friendly feeling which prevents him saying I am quibbling. However, he gives his reason for thinking I am quibbling. I will admit my offence if he will indicate precisely how an inborn trait is more inborn and less acquired than an acquirement. In my letter I implied that by "acquired character" biologists mean a trait developed under the influence of use or injury. Sir Ray Lankester insists that I am wrong. He says that Lamarck, the original user, employed the term to indicate a trait which is "abnormal," because the individual who developed it was exposed to an "abnormal environment." To quote his own words, "The new character or characters developed in response to the abnormal environment (which we assume to be allowed to act on the growing individual only, and not on its parents) are called by Lamarck —and those who wish to discuss Lamarck's theory— 'acquired characters' (*changements acquis*). The word 'acquire' is used to mean something 'added to' or 'changed in' the normal form of the species." He adds "That, I take it, is Lamarck's meaning, and it is what I, and others, have for more than twenty-five years accepted."

I cannot, of course, be sure of the identity of the "others" to whom Sir Ray alludes as having taken part in "a historical discussion," but the following passages are taken at random from men who were not unknown about that time. "Lamarck . . . attributed the changes of species chiefly to the effects of changes in the conditions of life—such as climate, food, &c.—and especially to the desires and efforts of the animals themselves to improve their condition, leading to a modification of form or size in certain parts, owing to the well-known physiological law that all organs are strengthened by constant use, while they are weakened or even completely lost by disuse."[1] "It seems difficult and well-nigh impossible to deny the transmission of acquired characters when we remember the influence which use and disuse have exercised upon certain special organs. It is well known that Lamarck attempted to explain the structure of the organism as almost entirely due to this principle alone."[2] "And so in the case of other animals, Lamarck believed that the adaptation of their forms to their habits could be explained by this simple hypothesis that the habits created the forms, through the effects of use and disuse, coupled with heredity. Such is what is ordinarily known as Lamarck's theory of evolution. We may as well remember, however, that it really constitutes only one part of his theory; for besides the hypothesis of the cumulative inheritance of functionally-produced modifications—to which we may add the inherited effects of any direct action exercised by surrounding conditions of life—Lamarck believed in some transcendental principle tending to produce gradual improvement in predetermined lines of advance. Therefore it would be more correct to designate the former hypothesis by the name either of Erasmus Darwin, or, still better, of Herbert Spencer. Nevertheless, in order to avoid confusion, I will follow established custom, and subsequently speak of this hypothesis as the Lamarckian hypothesis—understanding, however, that in employing this designation I am not referring to any part or factor of Lamarck's general theory of evolution other than the one which has just been described—namely, the hypothesis of the cumulative transmission of functionally-produced or otherwise 'acquired modifications.'"[3]

It will be seen that I have sinned, if I have sinned, in good company. The men from whom I quote evidently regarded an acquired character as, in essence, a "functional modification," an effect of "use or disuse," "to which may be added the inherited effects of any direct action exercised by surrounding conditions of life" (*e.g.* injury). I suppose I could cite scores or hundreds of similar passages. The fundamental errors expressed or implied in them all are (1) that there is a general law that *all* organs are strengthened by constant use and weakened by disuse, and (2) that use and disuse produce only "abnormal" traits. There is no such law; some structures (*e.g.* external ears, hair, teeth) in the higher animals (*e.g.* man) are not in the least affected by use; there is no clear evidence that animals low in the scale of life develop at all under this influence; and very clear evidence that the power, the potentiality, of so developing has undergone such increase in the higher animals that it constitutes the main feature of their evolution. To it they owe all their physical and mental adaptability—their intelligence, for instance. The child grows into the adult just as much under its influence as the adult grows into the exceptional adult (*e.g*: the trained athlete). We have every reason, therefore, to believe that the potentiality to develop under the influence of use, at any rate to any considerable extent, is a late and a high product of evolution. The point raised by Sir Ray Lankester is, however, as far as I am concerned, immaterial—a distinction without a difference. If he prefers, let us, by all means, consider abnormality resulting from abnormal use as the distinguishing characteristic of an acquirement. To take an illustration, the muscular development, both of the ordinary individual and of the blacksmith, is due to use. Sir Ray Lankester regards the former as normal, and *therefore* inborn

1 Wallace, "Darwinism," p. 3.

2 "Weismann on Heredity," English translation. 2nd edition, vol. i., pp. 83–4.

3 Romanes, "Darwin and After Darwin," vol. i., p. 255.

and inheritable, and the latter as abnormal, and *therefore* acquired and non-inheritable. If almost all men laboured as blacksmiths the positions would be reversed; that which to-day is normal and inborn would become abnormal and acquired. I regret, however, I am still unable to follow the line of thought which connects normality with innateness and inheritability, and abnormality with acquiredness and non-inheritability. In what respects is the normal character more innate and inheritable than the abnormal trait? If Lamarck's words, or the words of those who controverted him, had any meaning, what was that meaning?

Sir Ray Lankester objects also to my use of the word "stimulus." It seems, for example, that I express myself wrongly when I say that a muscle grows under the stimulus of use. I fear, if he is right, I do not know the meaning of the word. Here again, however, the point is immaterial. His own word "influence" will serve. The substitution does not affect the argument.

Darwin's theory of evolution through the natural selection of favourable variations—or at any rate what is known as the neo-Darwinian theory—is intelligible. It separates *likenesses and differences* between individuals (*e.g.* parent and offspring) into those which are inborn and inheritable and those which are acquired and non-inheritable. An inborn likeness or difference is one which depends on a likeness or difference in germinal potentiality; an acquired likeness or difference is one which depends on a likeness or difference in the action of the environment. On the other hand, the Lamarckian hypothesis, founded as it is on the notion that some *characters* (*e.g.* heads) are inborn, and others (*e.g.* scars) acquired, is not intelligible. The terms used are meaningless in the connection in which they are employed. Obviously, all characters depend equally on an interaction between germinal potentiality and external stimulus. They are all, therefore, as inborn and acquired, as blastogenic and somatogenic as they can possibly be. No such things are conceivable as purely blastogenic and somatogenic characters, or characters which are more blastogenic or somatogenic than others. The whole "historical discussion," therefore, is of the same order as would be one in which physicists discussed whether gravitation was blue or yellow.

The Lamarckian controversy is, in effect, ended. The great majority of biologists reject the hypothesis that acquirements are transmissible. The next step, I think, will be a rejection of the very notion that some characters are inborn and others acquired, and an acceptance of the reality that the different classes of characters are distinguishable from one another because they are responses to different kinds of stimuli—nutriment, use, injury, and the like. Doubtless we shall then have a discussion as to what characters, in the different species, develop under this stimulus, and what under that, and ultimately a general recognition of the immensely important truth that the peculiar characteristic of the higher animals is that the individual develops after birth more under the influence of use than under any other stimulus—hence the fact that man, the highest animal of all, is, as Sir Ray Lankester has often insisted, pre-eminently the educable animal both in mind and in body.

G. Archdall Reid.

Southsea, March 29.

Red Water.

A sample of red water from a crater lake in Uganda, which "looks like blood at times," sent by Dr. R. van Someren presents some features of interest.

The colour was separated by filtration through a Berkefeld filter, but not through filter paper. It disappeared on the addition of a mineral acid or caustic alkali, and was not extracted by ether. The red deposit on the Berkefeld filter consisted of disintegrated organic remains. From the water itself mixed with nutrient agar a bacterial culture was obtained, which did not develop either in an artificial brine or in ordinary culture media.

A litre of the red water contained 247 g. sodium chloride, 96·8 g. sodium carbonate, 53·8 g. sodium sulphate, 10·5 g. potassium chloride, 5·1 g. sodium bicarbonate, and 2·4 g. sodium phosphate.

As the chemical composition of the water gives no clue to the colouring matter, it is probably due to an organism capable of growing in a practically saturated alkaline brine.

We should be glad to know of the occurrence of similar red brines and the causes of coloration.

John E. Mackenzie.
T. M. Finlay.

Chemistry Department, University of Edinburgh, March 28.

April Meteor-showers.

The following are the most important meteor-showers that become due between April 5 and the end of the month:—

Epoch April 6, 20h. (G.M.T.), 1st order of magnitude. Principal maximum, April 7, 12h. 45m.; secondary maximum, April 8, 5h. 30m.

Epoch April 9, 3h., 11th order of magnitude. Principal maximum, April 7, 16h. 15m.; secondary maximum, April 8, 14h.

Epoch April 7, 14h. 30m., 10th order of magnitude. Principal maximum, April 8, 5h.; secondary maximum, April 10, 10h. 40m.

Epoch April 14, 12h. 30m., approximately 16th order of magnitude. Principal maximum, April 14, 4h. 10m.; secondary maxima, April 13, 6h. 30m. and 10h. 30m.

Epoch April 13, 22h., 3rd order of magnitude. Principal maximum, April 15, 13h. 30m.; secondary maximum, April 15, 16h. 30m.

Epoch April 16, 17h., approximately 10th order of magnitude. Principal maximum, April 17, 4h.; secondary maximum, April 19, 0h. 45m.

Epoch April 21, 4h., 1st order of magnitude. Principal maximum, April 20, 21h. 30m.; secondary maxima, April 20, 10h. 20m., and April 21, 11h. 30m.

Epoch April 23, 6h., approximately 10th order of magnitude. Principal maximum, April 24, 10h. 55m.; secondary maxima, April 23, 11h. 50m., and April 25, 10h.

Epoch April 26, 6h., approximately 4th order of magnitude. Principal maximum, April 26, 11h. 50m.; secondary maxima, April 26, 7h. 40m., April 27, 10h. 50m., and April 28, 0h. 55m.

Epoch April 29, 14h., 7th order of magnitude. Principal maximum, April 28, 2h. 15m.; secondary maximum, April 28, 8h. 35m.

The maxima about April 20–21, though belonging to an epoch of the first order of magnitude, are not so strong as they might be, the night maxima especially being rather weak. The maxima have been so computed that when observations are possible shooting stars should be seen within a few minutes from the predicted times. The heaviest maxima of the month are the principal maxima that occur on April 17 and April 24 respectively.

John R. Henry.

Dublin.

MAN OF NEANDERTHAL TYPE IN THE CAMBRIDGE FENS.

The bones of primæval man are so rare, and there is so much uncertainty as to the mode of occurrence and association of the earlier specimens, that it is important to place on record any new case which may be brought under our notice. I have had the good fortune lately to assist in digging out the skeleton of a man whose skull was distinctly of Neanderthal type. In this case I think I am justified in using that name, because as much as was preserved of the Neanderthal man is represented in the skull now described, and is similar to it.

We cannot compare the Neanderthal man, whose lower jaw was lost, with the man of Mauer, near Heidelberg, of whom only the lower jaw has been preserved. But we have the lower jaw of the man found near Shippea Hill in the Cambridge Fens, and it differs in essential characters from that of Mauer. The skull of the Shippea man differs also in form from those of Sainte Chapelle, described by M. Marcellin Boule. The general section across the ground is as shown in Fig. 1. An island of Kimeridge Clay, known as Shippea Hill, rises out of the fen about 3 miles E.S.E. of Littleport, and on it a farm represents the site, and preserves some of the ancient masonry, of a monastic retreat connected with Ely.

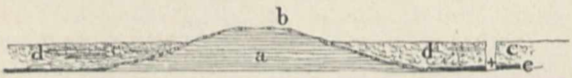


Fig. 1.—Shippea Hill. *a*, Kimeridge clay; *b*, gravel; *c*, peat; *d*, white marl; *e*, Buttery clay; +, position of skeleton.

On the Littleport side the peat, with beds of white marl in it, rests at a depth of from 4 to 6 feet on a blue-grey fine unctuous clay, which we refer to as the Buttery Clay. This contains large shells of the common cockle with valves adherent, *Tellina* (*Tacoma*) *balthica*, *Scrobicularia piperata*, and other estuarine shells, and, in the peat above it, bones of the Urus, wild boar, and beaver have been found.

On the south side of Shippea Hill the section is much the same, but here we have not, so far, found the estuarine shells in the Buttery Clay. Freshwater shells occur commonly in the white marl and less commonly in the peat.

The skeleton was found in digging trenches through the peat in order to obtain the underlying clay to lay on the land, so that a clean cut was made down to the Buttery Clay in each trench.

Mr. Luddington, to whom the property belongs, and Mrs. Luddington, who has a collection of objects from the fens, informed us of the discovery, and gave us every facility for investigating the circumstances on the spot at once. We were thus able to examine the section and collect a large number of the fragments of the skull and other bones of the skeleton which had been overlooked at first.

The skeleton was found between Shippea Hill Farm and the railway, about 4 feet down in the peat, and a few inches above the Buttery Clay. It was bunched up so that all the bones were packed into a space not more than two feet square. It looked as if the man had been mired and sunk straight down exhausted, and not as if a dead body had been carried down by water. The character of the peat also precludes this supposition, for it is peat grown on the spot, and not travelled peat, though in that often-flooded area it readily becomes sludge, and penetrates into any cavity. I lay stress upon this point because I know from my own experience in excavations that there are sources of error in speculations as to the original form of fossil skulls.

If a sepulchral urn has not been tightly filled before interment, and the interior is capable of compression, it is commonly crushed, or, if not well fired, squeezed out of shape, without much fracture, and on drying retains its flattened form. Skulls also, if buried under conditions which do not allow of their being filled *pari passu* with the disappearance of the organic matter inside, are sometimes, of course, crushed flat, but sometimes only deformed by the pressure, and, when dried, appear to be of abnormal shape. In the example now described, however, the peat filled the skull and preserved its form against the small pressure of the overlying spongy material. Unfortunately it got broken in the first excavation, but the fragments were not deformed, and readily fell into their place in the rotundity of the cranium. It has now been skilfully restored by Mr. C. E. Gray, and I hope on a future occasion to be able to offer a full description of it by an expert.

I will only point out now that it is a good round skull, somewhat largely developed posteriorly, but not elongated into a conical projection in the occipital region. It agrees very well in its *norma verticalis* with the Neanderthal skull. (See Fig. 2.)

The most conspicuous feature is the prominent brow, its strong supraciliary ridges and flattened forehead bringing it again into comparison with the Neanderthal skull. (See Fig. 3, side view, and Fig. 4, front view.)

There is very little of the face or upper jaw preserved. The lower jaw of the Neanderthal man is missing; so here our comparison with that example ends. In the Shippea Hill man the lower jaw (see Fig. 5)[1] is well preserved. It does not show the flat or receding chin of the Mauer jaw or of some of those recently described by M. Marcellin Boule. The teeth are large, strong, and sound, but curiously worn down obliquely on the outer margin, as if the upper jaw had been somewhat broader than the lower.

Here, therefore, is a man whose skull shows all the characteristics of that of Neanderthal, including the prominent supraciliary ridges, but having in addition a powerful lower jaw, and large terminations to his limb bones, and found undoubtedly *in* the peat of the fens.

[1] The drawings Figs. 1 to 5 are by the skilful and experienced pencil of Mr. Edwin Wilson.

I reserve discussion of the possibility of this part of the peat being of more ancient date than that to which it has generally been referred—an opinion which might be suggested by the occurrence of *Rhinoceros tichorhinus* under the peat at Little Downham, or of the still older *Elephas antiquus* under the margin of the fen deposits near Whittlesea, and will content myself now with stating my own conviction that the peat in which the Shippea man was found cannot be older than Neolithic times, and may be much newer.

Notwithstanding his Neanderthal character I should not be surprised to find that he was a man of much later date, even a monk from Ely, per-

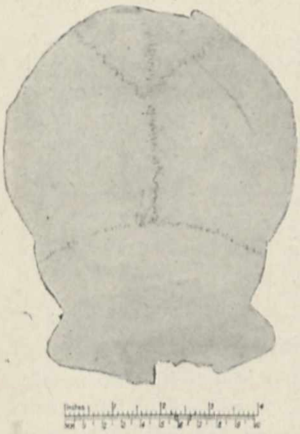


Fig. 2.

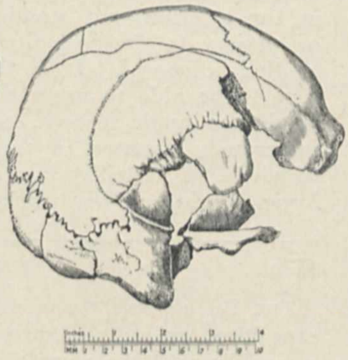


Fig. 3.


Fig. 4.

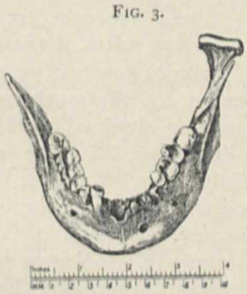


Fig. 5

haps a foreigner, who had lost his way and sunk down in the peaty swamp of the then undrained fens.

T. McKenny Hughes.

THE INTERNATIONAL RADIUM STANDARD.

THE committee formed at the Brussels Congress of Radiology and Electricity in September, 1910, for the purpose of fixing an international standard of radium, of which a full account appeared in Nature of October 6, 1910, met in Paris from March 25–28. There were present Mme. Curie, MM. Debierne, Rutherford, Soddy, Hahn, Meyer, and Schweidler. MM. Geitel, Eve, and Boltwood were unable to attend. The main purpose of the meeting was to compare the standard prepared by Mme. Curie with others prepared by Hönigschmid from the material in possession of the Académie des Sciences at Vienna, during the course of his new determination of the atomic weight of radium, referred to in Nature of March 21 (p. 68). Mme. Curie's standard consisted of 21·99 milligrams of radium chloride specially prepared by methods similar to those used by her for atomic weight determination, and sealed up in a thin glass tube with every precaution against error. The Vienna standards consisted of three tubes, containing respectively 10·11, 31·17, 40·43 milligrams of radium chloride, which were sealed up in somewhat wider glass tubes, but of the same thickness of wall (0·27 mm.) as the other, and were prepared by methods based on those devised by T. W. Richards for weighing hygroscopic substances.

It may be recalled that Hönigschmid found the value 225·95 for the atomic weight of radium, which is 0·45 lower than that found by Mme. Curie. This is a difference of only 1 part in 500, and, considering the small amount of material, is probably not due to differences in the purity, especially as certain corrections, such as for the solubility of the silver chloride, were introduced into the calculation of the atomic weight from the later determinations. It was therefore of the greatest interest to compare directly these two sets of entirely independent standards. Mme. Curie was sufficiently recovered from her recent illness to take some part, both in the deliberations and measurements of the meeting. Prof. Rutherford was chosen as the president of the committee.

After a visit to Mme. Curie's laboratory in the rue Cuvier, the committee proceeded to the Sorbonne, where, in Prof. Lippmann's department, a room, uncontaminated by radium, had been set apart for the measurements. Here M. Debierne had set up an interesting installation, capable of comparing the γ-rays of the standards by two distinct methods. The first method is based on the well-known null-method, largely employed in Paris, but hardly anywhere else, involving the quartz piézo-électrique of Pierre Curie. The ionisation current due to the γ-rays of the preparation was balanced by the electricity generated by relieving the tension of a stretched quartz lamina, by gradually lifting a weight from the pan, the electrometer needle so being held to its zero and the time measured from the commencement to the end of the lifting of the weight. This requires practice, and the admirable skill of the French observers with the method was humorously illustrated by the attempts of some of the visitors to emulate them. The form of ionisation chamber adopted calls for special remark. The radium standard was laid on the centre of a large circular disc of lead, 1 cm. thick, which formed the upper plate of a condenser, the distance between the plates being small compared with their diameter. A potentional of 800 volts was used to ensure saturation.

The other method was that recently described at the Physical Society by Rutherford and Chadwick, and is also a null-method, the γ-ray ionisation being exactly balanced by a special form of Bronson's "air resistance." The special feature of the arrangement is that the radium standard is mounted on an optical bench at a distance from a lead ionisation chamber, and the distance is varied until exact balance is obtained. The strengths of different preparations are proportional to the square of the distances, correction being made for air absorption of the γ-rays. Each method naturally has its own advantages and range of applicability.

After comparisons by both methods, the gratifying result was arrived at that the Paris and Austrian standards agreed perfectly with one another within the limits of error of the measurements. Naturally, to obtain the highest possible accuracy with the methods, a much more extended series of measurements than was possible in the short time available would have been necessary. But it was clear that the error of measurement was certainly not greater than 1 part in 300, and was probably much less. For example, for two single comparisons, the 31·17 mg. Vienna standard came out as 31·24 mg. and the 10·11 mg. as 10·13 mg. in terms of the Paris standard. The standards being entirely independent, this result reflects the greatest credit on the care and accuracy bestowed by Mme. Curie and the other investigators responsible for their preparation and for the methods of measurement. In future it will be possible to evaluate the quantity of radium in a preparation, in the absence of other radioactive substances giving γ-rays, by simple γ-ray comparison with these standards without any chemical operations and without opening the tube in which it is sealed, with an accuracy of at least 3 or 4 parts in 1000.

The committee also had the advantage of having a standard, sent by Sir William Ramsay, and prepared from material employed in the just-published atomic weight determinations by him in conjunction with Whytlaw Gray (Proc. Roy. Soc., 1912, 86 A, 270). The quantity of radium was much smaller than in the others, and corresponded to less than 4 mg. of radium chloride. In addition, it was not comparable, either in the manner of its preparation or of its mounting, with the others, the tube in which it was contained being of quartz, relatively thick in the wall. For these reasons no definite comparison was possible of the same degree of accuracy as for the others.

The committee accepted Mme. Curie's standard as the International Radium Standard, and will ask for its preservation in the Bureau International des Poids et Mesures in Paris. They have arranged for the 31·17 mg. Austrian standard to be similarly preserved in Vienna as a reserve standard. These standards are hereafter only to be used for purposes of comparison by the committee, and are not to be taken away from the cities mentioned or to be used for experiment. Arrangements have been made for the preparation of secondary standards, of between 10 and 40 milligrams of radium chloride, to be provided to the Governments of the various countries desiring them for their official testing institutions. These secondary standards will be compared independently at Paris and Vienna with the international and reserve standards, and will be supplied with a certificate showing the result of the comparisons. Further particulars may be obtained from the secretary of the committee, Prof. Stefan Meyer, Institut für Radiumforschung, Waisenhausgasse 3, Wien IX, Austria.

In the course of a few months it will be possible for each country to possess a radium standard which has been compared directly with the international standard, which will enable measurements to be made in future with complete confidence, and will be invaluable both for scientific and commercial comparisons.

The necessity of refunding to Mme. Curie a quantity of radium equivalent to that contained in the international standard has been a source of anxiety to the committee, who have no funds at their disposal. It is therefore most satisfactory to be able to announce that as soon as the need was made known, the sum necessary was generously donated in this country by Dr. and Mrs. G. T. Beilby as a personal tribute to Mme. Curie and her work.

NOTES.

The *Terra Nova*, the vessel of the British Antarctic expedition, arrived at Akaroa, New Zealand, on April 1, and brought the news that on January 3 Captain Scott and five other members of the expedition were within 150 miles of the south pole, and that he intends to remain another year in the Antarctic. A detailed account of the work accomplished by the expedition has been obtained by the Central News, Ltd., agency, and appeared in the daily papers on Tuesday and Wednesday. Captain Scott left the base at McMurdo Sound on November 2, 1911, for the poleward journey, and had arrived at latitude 87° 32′ S. on January 3. Nearly three weeks before this date Captain Amundsen had reached the south pole. Though Captain Scott has thus been forestalled as regards the first arrival at lat. 90° S., the scientific results of the British expedition promise to make up for any disappointment which may be felt from the point of view of national sentiment. Specimens of coal of economic value, and well-preserved fossils, have been found near Granite Harbour by the western geological party. Marine biological work has been carried on continuously, and every phase of seal, penguin, and skua-gull life has been photographed with the kinematograph. By means of small balloons the direction of atmospheric currents has been studied up to a height of six miles, and the temperatures have been recorded up to a height of five miles. Valuable magnetic, electrical, tidal, pendulum, and other observations relating to terrestrial physics have been made, and much has been done also in the fields of ice work and physiography. A summary of scientific work accomplished was published yesterday, and we hope to refer to its details next week. Meanwhile, we offer to Captain Scott and the other members of the British Antarctic expedition the thanks of the scientific world for the attention being given to systematic observations, which are of far greater value than the attainment of the south pole. By deciding to spend another winter in the Antarctic, Captain Scott has given us additional cause to be grateful to him, and we may look forward confidently to a harvest of results of prime importance when the expedition returns to civilisation next year.

A SUMMARY of the weather for the first quarter of the present year, as shown by the results for the thirteen weeks ended March 30th, issued by the Meteorological Office shows that the conditions were generally mild and wet over the United Kingdom. The mean temperature for the whole period was everywhere above the normal, the greatest excess occurring in the eastern and midland districts of England. The aggregate rainfall was in excess of the average everywhere, except in the north of Scotland, where the deficiency was rather more than 3 in. The largest total measurement of rain was 13·56 in. in the south-west of England, where the excess on the average was 4·15 in. The next greatest excess was 3·51 in. in the Channel Islands, and this was followed by 3·28 in. in the midland counties and 3·05 in. in the south-east of England. The largest number of rainy days in any district was 72 in the south of Ireland and 70 days in the south-west of England. The number of rainy days was in excess of the average in all districts, except in the north of Ireland. The duration of bright sunshine for the period was everywhere deficient, except in the north of Scotland, where there was a slight excess. At Greenwich the mean temperature for the three months was 44°, which is 3·5° in excess of the average, and it was 3·5° higher than for the corresponding period in 1911. The mean temperature was in excess of the average in each month, the excess for the three months being respectively 1·7°, 3·7°, and 4·7°. The aggregate rainfall for the three months at Greenwich was 7·18 in., which is 2·30 in. more than the average; the excess of rain in the three months was respectively 1·07 in., 0·11 in., and 1·12 in. The total duration of sunshine at Greenwich was 159h., which is 28h. less than the normal, the deficiency in the three months being respectively 6h., 14h., and 8h.

THE crisis through which the country has passed during the last few weeks in relation to its fuel supply should expressly bring home to us the necessity for a more general appreciation of what lies ahead, and at no distant future, in the possible exhaustion, or at least very restricted output, of our coal measures. Many have directed attention to this grave problem, but the public attitude has been one of indifference, or, at most, a pious hope that something will replace coal. A useful pamphlet on "Natural Sources of Energy," being the report of a committee of the British Science Guild, just issued by the guild, appears at a particularly opportune moment, emphasising as it does the improbability of that useful find within the horizon of scientific knowledge and the need of serious efforts to check that enormous waste of coal which characterises our present methods. As Dr. Beilby shows, the saving by adoption of scientific methods might amount to 40 to 60 million tons per annum. How the turbine, gas-producer, and gas-engine—especially with utilisation of blast-furnace and coke-oven gas, so much of which is annually wasted or inefficiently utilised—can contribute to this economy is clearly shown. Oil engines, especially of the Diesel type, are shown to give high efficiency, but the enormous economic question of supply and output are clearly dealt with by Sir Boverton Redwood, according to whom the total crude oil output used under the best conditions is only equal to 15 per cent. of the coal. Other contributors to the report are Sir William Ramsay, the Hon. R. J. Strutt, Prof. V. B. Lewes, Mr. Dugald Clark, Sir Charles Parsons, and Mr. W. F. Reid.

The photography of colour by purely optical means, that is, without the use of pigments, dyes, or coloured screens, has been shown to be possible in two or three different ways. One of these methods was described and demonstrated with remarkable success by Messrs. Julius and Ernest Rheinberg at a meeting of the Royal Photographic Society held last week. These gentlemen have eliminated the practical difficulties of the process one at a time, and by their patient perseverance have produced a camera that conveniently serves for the taking of the photographs, for the viewing of them by means of an eyepiece, or for the projection of them upon a screen. An image of the view or object to be photographed is produced upon a ruled plate that has transparent lines alternating with much wider opaque lines. Behind the lined screen is a low-angled compound prism, so constructed and adjusted that it disperses the light that passes through each transparent line into a spectrum, which covers the otherwise blank space that corresponds to the adjacent opaque line. The whole surface, therefore, instead of being white and black is covered with these long, narrow spectra, which are narrow enough to be indistinguishable to the unaided eye, however the final picture is viewed. These spectra serve the same purpose as the three colours of an autochrome plate. A second lens focusses the image on to the photographic plate, which thus becomes a record of the original and all its colours. The optical part of the apparatus is so compactly arranged that it is all contained in a tube that is rather longer than a moderate-sized lens mount. Landscapes from nature, portraits, copies of pictures, photographs of jewellery, and of other subjects showed that the resulting colours were wonderfully true to the originals.

MR. C. E. ADAMS has been appointed Government astronomer for the Dominion of New Zealand.

PROF. E. METCHNIKOFF, assistant director of the Pasteur Institute at Paris, has been elected foreign associate of the French Academy of Sciences, in succession to Sir Joseph Hooker.

THE Turin Academy of Sciences has awarded the Vallauri prize of 800*l.* for contributions to the progress of physics in the period 1907–1910 to Prof. A. Righi and Prof. J. Perrin.

The council of the Manchester Literary and Philosophical Society has nominated the president, Prof. F. E. Weiss, to represent the society at the celebration of the 250th anniversary of the foundation of the Royal Society.

Prof. H. F. Newall, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

Sir David Gill, K.C.B., F.R.S., has succeeded Lord Cromer as president of the Research Defence Society; and Lord Cromer, Mr. Balfour, Sir Edward Elgar, O.M., Mr. Rudyard Kipling, and Lord Rayleigh, O.M., have consented to be vice-presidents of the society.

The death is announced, at the early age of thirty-nine, of Dr. T. H. Montgomery, jun., professor of zoology in the University of Pennsylvania. He had been assistant professor at the same University from 1898 to 1903, and professor at the University of Texas from 1903 to 1908. He was the author of an "Analysis of Racial Descent in Animals," and of numerous monographs on biological subjects.

Prof. Ralph S. Tarr, of Cornell University, has died suddenly of cerebral hæmorrhage. He was born at Gloucester, Mass., in 1864, and graduated at Harvard. He served for a while at the Smithsonian Institution, and in connection with the United States Geological Survey. He went to Cornell in 1892 as assistant professor of geology, and had since held successively the chairs of dynamical geology and physical geography. He had written a "Physical Geography of New York State," in addition to several valuable text-books of geology and physical geography. His special work was done in the study of earthquakes and glaciers, upon which he wrote a number of important papers.

The death is announced of Mr. Charles Edward Leeds, who made the first part of the remarkable collection of fossil reptiles from the Oxford Clay of Peterborough which now occupies a large portion of a gallery in the British Museum (Natural History). Mr. Leeds attended the lectures of the late Prof. John Phillips, and some of his earliest discoveries were described in the professor's "Geology of Oxford." He left England in 1887 to spend the remainder of his life in New Zealand, and since his departure the collection has been extended by his brother, Mr. Alfred N. Leeds, who still resides at his birthplace, Eyebury, Peterborough.

We regret to see the announcement of the death of Prof. P. N. Lebedew, professor of physics in the University of Moscow, who first succeeded in 1901 in demonstrating the pressure of light experimentally. Maxwell pointed out that the concentrated rays of an electric lamp falling on a thin metallic disc, delicately suspended in a vacuum, might perhaps produce an observable mechanical effect. This effect was thought to have been obtained in the Crookes's radiometer, but the magnitude proved many thousand times too great. Prof. Lebedew eliminated the radiometer action by using a large bulb with high exhaustion, and by excluding rays capable of heating the tube walls. His investigations proved that light exerts a true pressure on a surface on which it is incident, and the absolute magnitude of the pressure was found to be equal to that predicted by Maxwell. Prof. Lebedew's work led other investigators to take up the subject of the mechanical pressure of light, and the results obtained have been most valuable and suggestive.

The annual general meeting of the Chemical Society was held at Burlington House, W., on Thursday, March 28, Prof. Percy F. Frankland, F.R.S., the president, occupying the chair. The adoption of the report of the council on the progress of the society during 1911 was carried, and the president presented the Longstaff medal for 1912 to Dr. H. Brereton Baker, F.R.S. The president then delivered his address, entitled "Some Stereochemical Problems." Prof. Percy F. Frankland was re-elected president; Prof. E. J. Mills, F.R.S., and Prof. G. T. Morgan were elected vice-presidents; Dr. S. Smiles as hon. secretary, and Dr. H. G. Colman, Dr. A. Harden, F.R.S., Dr. T. M. Lowry, and Dr. E. J. Russell as new ordinary members of council.

The sixty-fifth annual general meeting of the Palæontographical Society was held in the Geological Society's rooms at Burlington House on March 22, Dr. Henry Woodward, F.R.S., president, in the chair. The annual report referred to the completion of the monograph of English Chalk fishes, and of the second volume of that of Pleistocene mammalia. It also acknowledged the help of the Carnegie Trust for the universities of Scotland in providing the plates for another instalment of Dr. Traquair's monograph of Carboniferous palæoniscid fishes. A special effort had been made to complete works in progress before beginning new undertakings. Miss Margaret C. Crosfield, Mr. George Barrow, Mr. H. R. Knipe, and Prof. W. W. Watts were elected new members of council. Dr. Henry Woodward, Dr. George J. Hinde, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

The Easter Vacation Classes and the number of workers at the Port Erin Biological Station promise this year to be considerably larger than on any previous occasion. Seventy-six senior students or post-graduate researchers in zoology, botany, or physiology (representing six universities) have now engaged work-places at the laboratory during April, and all the accommodation in the institution seems likely to be taxed to its utmost capacity. Planktologists elsewhere may be interested to know that the vernal phytoplankton has made its appearance in the Irish Sea this year at an earlier date than usual. Diatoms were present in great force in the plankton of Port Erin bay on March 18 for the first time this spring. On the other hand, this season's prospects in the hatchery are unfavourable. The spawning of the plaice in the ponds is later than usual, and the number of eggs produced is comparatively small.

The whole of the famous collection formed by the Rev. Canon Norman, F.R.S., consisting of North Atlantic and Arctic invertebrates other than insects, arachnids, and myriopods, has now become the property of the Natural History Museum, the fourth and last instalment having been received recently at Cromwell Road. The extent of this consignment may be judged when we state that of Mollusca there were specimens in 7114 glass-topped boxes, of Crustacea there were 7376 bottles and tubes containing specimens, and there were, in addition, 5544 microscopical slides. The Polyzoa were contained in 1063 glass-topped boxes, while there were 497 spirit specimens and 185 microscopical slides. The "lower invertebrata" were numerously represented in the earlier instalments. Students who desire to examine any specimens in the Norman collection should apply to the keeper of the Department of Zoology at South Kensington.

Announcement has been made of the following awards just decided by the council of the Royal Geographical Society:—With the approval of the King the two Royal medals have been awarded to Mr. Charles Montagu Doughty and Mr. Douglas Carruthers, the founder's medal to the former, in recognition of his explorations in Arabia, and the patron's medal to the latter, for his expedition in north-west Mongolia, including the upper basin of the Yenesei, the Altai mountains, and neighbouring regions, and for other explorations. The Victoria medal, for scientific research in geography, has been awarded to Sir George H. Darwin, K.C.B., F.R.S.; the Murchison bequest to Captain W. C. Macfie, R.E., who was appointed to the charge of the Uganda Topographical Survey in 1908, and in twenty months surveyed an area of 14,000 square miles; the Gill memorial to Captain F. M. Bailey, who in 1904 accompanied the expedition from Lhasa through Tibet, and last year travelled from the valley of the Yangtse westward to Sidiya, passing through about three hundred miles of unexplored country; the Cuthbert Peek fund to Mr. Cecil Clementi, who has travelled extensively in Central Asia, and made a careful series of astronomical observations for latitude and chronometric differences of longitude during his journeys; the Back bequest to Mr. L. A. Wallace for his explorations and surveys of the Tanganyika Plateau and the country round it.

At Hull, on Saturday last, March 30, a museum devoted entirely to objects connected with the fishing and shipping industries, which play so prominent a part in the city, was opened to the public. The museum, which is a large building, and top-lighted, is the gift of Mr. C. Pickering, J.P. The exhibits, which have been arranged by the curator, Mr. T. Sheppard, include an exceptionally fine series of harpoons, harpoon guns, flensers, blubber-spades, and other objects connected with the old whaling trade, which commenced at Hull in the sixteenth century, and may be said to have started the present flourishing oil and fishing industries. There are also dozens of models of ships, illustrating the evolution and growth of the vessels from the old "wooden walls" to modern battleships and liners, all built at Hull. The various phases in the evolution of the old fishing smack to the modern steam trawler are also shown by models. A valuable set is shown of Eskimo boats and fishing appliances, brought to Hull during the early part of last century, by the old whalers. Preparations are exhibited showing the growth of the prawn, trout, eel, carp, oyster, &c., and others illustrating the nervous system, blood-vessels, skeleton, and other parts of fishes. There is a representative set of skeletons of whales and fishes, large and small, and a large number of mediæval and later earthenware vessels, which have been dredged up from the Dogger Bank by the Hull trawlers.

In the *National Geographic Magazine* for January Mr. F. E. Johnson describes the remarkable series of Greek bronzes discovered by M. A. Merlin in 1907 in the wreck of a sunken galley near the little town of Mahdia on the coast of Tunis. The almost life-size statue of Eros attributed to Praxiteles is a wonderfully beautiful object, and it is almost equalled by the Running Satyr and the Hermes of Boethus, the Chalcedonian. There seems good reason to believe that this galley was chartered to convey to Rome the spoils of Athens after the attack by Sylla in 86 B.C., just as Mummius appropriated for himself, his friends, and the temples of Rome the spoils of Corinth. It is very creditable to M. Merlin, director of antiquities and fine arts in Tunisia, that with little assistance from his Government and by means of very rude appliances he has been able to recover this wonderful collection of works of art.

In the Bulletin of the Royal Academy of Sciences of Belgium (1912, No. 1, pp. 8–9) Prof. L. Dollo describes the remains of a fresh-water tortoise of the genus Podocnemis, from the Lower Eocene of the Enclave de Cabinda, Congo State. Although now restricted to tropical South America and Madagascar, the genus is represented in the Eocene of England, India, the Fayum, and the Congo, and would thus seem to have reached its present isolated habitats from the north.

Starting with the premiss that an increase in the weight and dimensions of a flying animal involves a still greater increase in the power necessary to drive the animal through the air, and that in consequence a limit is soon reached under existing physical conditions beyond which flight is impossible (such limit having probably been approximately attained by the largest existing flying birds), Messrs. E. and A. Harlé, in a paper published in vol xi., p. 118, of the *Bull. Soc. Géol. France,* urge that the power of flight possessed by the giant pterodactyles of the Cretaceous and the huge dragonflies of the Carboniferous was due to an augmentation of the atmospheric pressure as compared with that of the present day.

In a recent paper published in the Bulletin of the Imperial Academy of Sciences of St. Petersburg (February, 1912, pp. 219–236), Prince Galitzin considers the dispersion and damping of the seismic surface-waves due to the friction of the displaced material. He concludes that the velocity with which the waves spread over the surface decreases as the period of the waves increases, from 3·70 kms. a second with a period of one second to 3·07 kms. a second with a period of forty seconds.

The last four numbers of the *Bollettino* of the Italian Seismological Society contain the notices of the earthquakes recorded in Italy during the first 10½ months of 1908. Even for so short a time the catalogue contains accounts of more than 500 local shocks and ninety-four distant earthquakes. Among the former, it is interesting to note the frequent recurrence of the names of Messina, Reggio, and other places ruined towards the close of the year, pointing to the gradual preparation for the great earthquake which was unheralded by warning tremors. The eruption of Etna in 1908 was accompanied by a remarkable series of earthquakes, of which full details are given. Under the editorship of Dr. G. Martinelli, the catalogue has been recently enlarged and improved. If, however, to the details usually given for each earthquake, the approximate position of the epicentre, the maximum intensity of the shock, and the dimensions of the disturbed area could be added, the value of the "notices" would be greatly increased.

Messrs. Negretti and Zambra have recently devised a new type of instrument for recording continuously the direction of the wind. The record is traced on the chart by means of a single pen actuated by the vane. The pen is carried by a pivoted lever, having at one end a roller engaging with the cam surface of a spiral groove, which is attached to the spindle of the vane. As the vane rotates, the lever moves up or down and the pen records the motion on an appropriately ruled chart. In order to surmount the difficulty introduced by continuous rotation in one direction, the cam is provided at the highest point with a gap through which the lever falls, while at the lowest point a spring is brought into action by a secondary cam, and raises the lever. This arrangement involves duplicate points on the chart, and for half the compass the pen may be in one of two positions. This is a disadvantage which will probably be removed in the course of time. The makers are to be congratulated on the ingenious manner in which the primary difficulty has been overcome.

According to hydrodynamical theories, wave motion in deep liquids is accompanied by a gradual displacement of the liquid as a whole, this displacement being greatest at the surface. A general investigation, embracing an extension of Stokes and Rayleigh's theorems, is given by Prof. T. Levi Civita in the *Atti dei Lincei*, xxi., 1, for the case of waves in canals of any type whatever.

Messrs. E. Leitz have sent us a large wall-diagram which they have issued illustrating the construction and optics of the microscope. The mechanical parts and lenses are drawn in section, so as to show their construction, and coloured lines depict the paths of the rays of light through the optical system and the formation of the magnified image. The diagram should be very useful in laboratories for demonstrating to students the construction and optics of the instrument. A descriptive pamphlet is issued with it.

Bulletin No. 53 of the University of Illinois deals with the inductance of compact coils of wire without iron cores, and is written by Prof. Brooks and his assistant, Mr. Turner, for the use of engineers. It collects together a large amount of information as to the dimensions and weights of bare and cotton- or silk-covered wire, and gives a general formula for the inductance of coils of almost any shape the wire of which is wound without considerable spaces between the turns. If l is the length of wire on the coil, R the outer radius, b, the length, and c the radial depth of the coil, the self-inductance

$$L=\frac{l^2}{b+c+R}\times\frac{10b+12c+2R}{10b+10c+1\cdot4R}\times 0\cdot5\log\left(100+\frac{14R}{2b+3c}\right)\times 10^{-9}\text{ henries.}$$

The ratios of the dimensions which give the maximum inductance for a given length of wire are $b:c:R=12:10:20$. The inductance formula has been tested on nineteen coils of different shapes, the inductances of which were determined at the Bureau of Standards, and in no case was the calculated value so much as 3 per cent. different from the observed.

According to theory, two stereoisomers of symmetrical dichloroethylene should exist. Two symmetrical diiodoethylenes are known, and in the *Comptes rendus* of the Paris Academy of Sciences for March 18, G. Chavanne describes the isolation of the corresponding chlorine derivatives, hitherto unknown. Commercial dichloroethylene was fractionated in a Young column of eight sections, and was separated into approximately equal amounts of two isomers, boiling at 49° C. and 60·2° C. respectively; both gave figures on analysis corresponding with the constitution $C_2H_2Cl_2$. Contrary to expectation, the dibromides $C_2H_2Cl_2Br_2$ obtained from each by the action of bromine are identical, and further work on the space relations of these isomerides is in progress.

An index to Nos. i.–xvi. of the *Annual* of the British School of Athens has been compiled by Mr. Arthur M. Woodward. Its main purpose is to make more accessible the contents of the reports of the excavations undertaken by the school, or in connection with it, especially those at Knossos, Palaikastro, and Sparta. The index may be obtained from Messrs. Macmillan and Co., Ltd., and its price is 10*s*. net.

Messrs. Watts and Co. have published for the Rationalist Press Association, Ltd., at the price of sixpence, a new and revised edition of Sir Ray Lankester's "The Kingdom of Man." The author has revised "the text so far as to alter here and there the terms of reference to events and discoveries which are now six years older than they were when the book was first printed." An improved figure showing the relative size of the cerebral hemispheres in the extinct mammal Dinoceras and large mammals now living has been substituted for that previously published.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM AND ORBIT OF β SCORPII.—In No. 14, vol ii., of the publications of the Allegheny Observatory, Drs. Daniel and Schlesinger discuss the measures of seventy-three spectrum plates of β Scorpii and deduce an orbit. They confirm Dr. Slipher's statement that the H and K calcium lines do not share in the large oscillations shown by the other lines. As in δ Orionis and ο Persei, the velocity shown by these lines is approximately the velocity of the centre of mass of the system, thus indicating that the absorbing material producing the lines is really part of the system. Other notable features are the great eccentricity of the orbit, excessive for a star of the B type with so short a period, and the comparatively large masses of the components.

THE AXIS AND COMPRESSION OF MARS.—Including observations up to 1909, Dr. Struve has determined the axis of Mars, from the shifts of the orbital planes of the satellites, which confirm similar values found by him in 1896. He finds the obliquity of the planet's equator to the orbit to be 25° 10·2′, a value which, as Dr. Crommelin points out in the current number of *The Observatory*, is about the mean of previous determinations from observations of the snowcaps; Herschel gave 28°, while Prof. Lowell's latest value was 23°. The compression of the planet is given as 1/190·4, and the mass as 1/3,090,000, the same as formerly adopted. The daily angular motion of Phobos is 1128·844°, and of Deimos 285·162°.

OBSERVATIONS OF NOVA GEMINORUM NO. 2.

MANY observations of the nova, of which we give a selection below, are reported in No. 4563 of the *Astronomische Nachrichten*. The observations of magnitude are not very accordant, but they indicate that the nova was probably discovered before it reached its greatest brightness.

Prof. Wolf reports that there was a star brighter than magnitude 12·0 in the position of the nova on March 7, while two Harvard photographs showing eleventh-magnitude stars do not show the nova on March 10; but two plates taken on March 11 show it as a fifth-magnitude star. A plate taken by Dr. Kopff in 1909 shows the image of a fifteenth-magnitude star which is probably identical with the nova. Some of the magnitude estimations are given in the following table:—

Date	G.M.T.	Magnitude	System	Observer
	h. m.			
March 13	7 45	4·1	Harvard Revised	Strömgren
14	10 30	3·6	—	Wirtz
15	6 30	4·18	P.D.	Guthnick
15	9 30	4·31	,,	Freundlich
15	11 42	4·5	,,	Guthnick
16	7 15	5·42	Harvard Revised	Felix de Roy
17	8 49	5·37	P.D.	Graff
20	7 29	5·34	,,	,,
20	11 49	5·51	,,	,,
24	—	4·6±	—	Nijland
24	—	5·0±	—	Easton
26	—	5·5	—	,,
27	—	6·5	—	Easton ; Nijland

In communicating the last four values, Dr. C. Easton directs attention to the oscillations of brightness indicated by the recrudescence observed on March 24, when he observed at Amsterdam and Prof. Nijland at Utrecht; both observers were hampered by clouds and moonlight.

M. de Roy estimated the colour to be orange-yellow, 5·5 c. on Osthoff's scale, as seen in an 8-in. reflector, and Dr. Hartwig gives it as reddish.

Prof. Wolf states that the spectrum on March 15 was similar to that of Nova Aurigæ, but on March 17 it was more like that of Nova Lacertæ during the period January 6–14, 1911. On March 14 Herren Struve, Guthnick, and Freundlich saw broad absorption lines at Hα and Hβ, and the last-named suspected bright condensations in several places; a bright line in the yellow is given as probably D or D_3. Prof. Hertzsprung saw the H and K absorption lines doubled on March 15, the one part being very narrow and in its normal position, the other being about 7 A.U. broad, and, in the mean, displaced by an amount corresponding to −650 kms. per sec. A large number of fine absorption lines similar to those in a spectrum of F type were also seen. Prof. Schwarzschild states that the observations made with the Potsdam spectrograph, No. 1, on March 15, showed a number of absorption lines about 1 A.U. in breadth. Among these are well-defined lines of the spark spectrum of titanium, indicating by their displacements a radial velocity, referred to the sun, of −540 kms. per sec. On March 17 the displacements of these lines indicated a motion of −350 kms. per sec. in the line of sight. Observations on March 17, 18, and 19 indicated that the continuous spectrum was becoming weaker relatively to the bright bands.

Some interesting spectroscopic results secured by M.M. Hamy and Millochau at the Paris Observatory are published in No. 13 of the *Comptes rendus* (March 25). Two spectrographs were employed, one with a slit giving a spectrum 40 mm. long from Hβ to K, the other an ultra-violet prismatic camera giving the same length of spectrum between λ500 and λ300. On the plates secured with the latter the continuous spectrum is seen easily to extend to λ315, a fact which is accepted as showing the extremely high temperature of the light-source.

A large proportion of the total radiation from the star is shown to be concentrated in the bright hydrogen lines, which are about 20 A.U. in width, and become more and more diffuse towards the violet end of the spectrum. Hβ is divided into three equal parts and a similar division is suspected in Hγ; Hδ, Hε, Hζ, and Hθ are also shown. These broad, bright hydrogen lines are strongly displaced towards the red by an amount equivalent in Hβ, Hγ, and Hε to 3 A.U., and each is accompanied by a broad absorption band on the more refrangible side; the dark hydrogen bands are, as usual, considerably displaced, and have fine, bright reversals running down their centres. The displacements are equivalent to those that would be produced by a radial velocity of the order of −1300 kms. per sec. in the atmosphere of hydrogen, which produces the double reversals. The authors, however, attribute the broadening and the displacement of the lines to the enormous pressures which might be produced in the cataclysm following the impact of a star and a nebula, such as was outlined in Seeliger's theory.

Many apparently bright lines occur between λ470 and λ390, but the authors are not sure that these are not merely the interspaces between feeble absorption bands; they do, however, affirm the existence of a fine absorption band at λ304. Between λ370 and λ315, only continuous spectrum is seen, and the spectrum as a whole is similar to those of Novæ Aurigæ (1892), Persei (1901), and Geminorum (1903).

THE SHUMAN SUN-HEAT ABSORBER.

MOST of the experimenters who have attempted to make direct use of the sun's heat for the production of power have adopted the practice of greatly concentrating the sun's rays and focussing them on to a comparatively small and strong boiler generating steam at a fairly high pressure. Mr. Frank Shuman has used a concentration of only two to one, though in the next plant, which will be materially different (due to certain recommendations of Prof. C. V. Boys, F.R.S.) from the one herein referred to, the concentration will be three to one. The boilers are lamellar, about a yard square, and only about one-quarter inch thick. They are made of thin tinned copper, painted dull black on the outside, with a number of opposed indentations, the tinning holding the two sheets together where these indentations touch.

The boilers are fixed in shallow boxes placed nearly horizontally, and having double glass tops with an air space of one inch between the two sheets of glass. Between the lower sheet of glass and the top of the boiler there is another air space of one inch, and below the boiler an air space of about half an inch; then a sheet of millboard one-quarter inch thick, then two inches of granulated cork, and, lastly, a second sheet of millboard three-eighths of an inch thick forming the bottom of the box. Each such unit is a yard square, but twenty-two of them are constructed side by side in one frame, forming one section, and in the plant tested there were twenty-six such sections, thirteen on each side of the main steam pipe. To the top edge of each unit a silvered glass mirror a yard square is attached making an angle of 120° with the glazing of the unit. To the bottom edge a similar mirror is similarly fixed. The top edges of the mirror are thus six feet apart, while the bottom edges are three feet apart; hence the concentration of two to one.

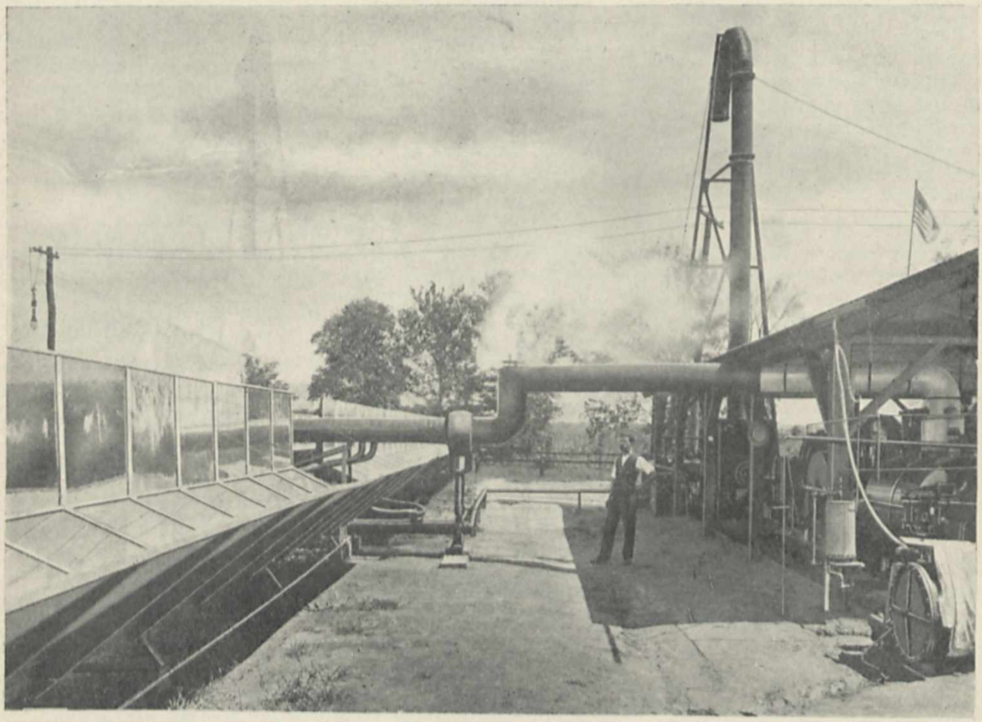


FIG. 1.—Showing one section of absorber on left, steam main and safety valve in centre, and part of engine on right.

Along the bottom of each section there is a small pipe for supplying the feed water, while a larger pipe runs along the top edge to collect the steam and convey it to the eight-inch main steam pipe. Each section is supported by, and pivoted to, steel A frames, each with a notched quadrant, so as to enable the section to be inclined at different angles. Herein is another distinct feature of the Shuman sun-heat absorber. Practically all the absorbers using great concentration of the sun's rays have had to be focussed continuously on to the sun, but the absorber now being described needs adjusting only once about every three weeks, the adjustment being such that the rays at noon are perpendicular to the top surface of the boilers.

When experimenting at Philadelphia in July, 1910, with a single unit *and no mirrors*, the maximum temperature I recorded under the lower cover glass was 250° F., and temperatures of over 200° F. were common. Even in the latter cases steam was formed freely, showing that the temperature of the boiler was 212° F.

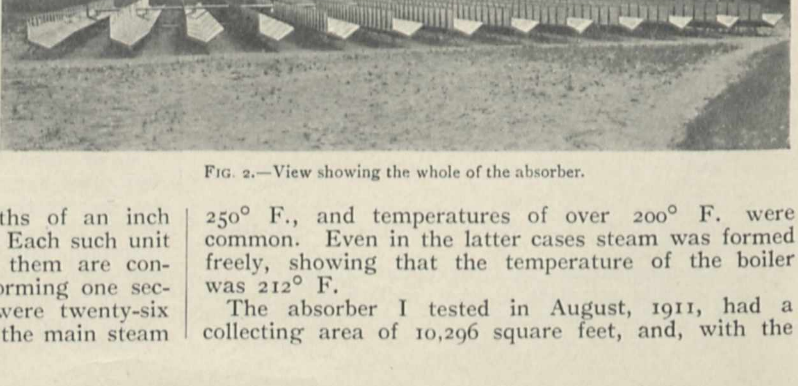


FIG. 2.—View showing the whole of the absorber.

The absorber I tested in August, 1911, had a collecting area of 10,296 square feet, and, with the necessary gangways, occupied an area of nearly two-fifths of an acre. The maximum quantity of steam produced in any one hour was more than 800 lb. at atmospheric pressure, and while this is by far the greatest quantity ever produced by sun power, it must be pointed out that Philadelphia is by no means an ideal situation for such a plant, for we had to wait weeks to get a nearly cloudless day, and then fortunately had three in succession. 800 lb. of steam per hour is equivalent to a boiler efficiency of 43 per cent. The plant was built at Philadelphia simply for the convenience of being close to the inventor's house, offices, and laboratory. In places like Egypt, Africa, Arizona, and California, I should expect to get about 25 per cent. more steam for the same collecting area.

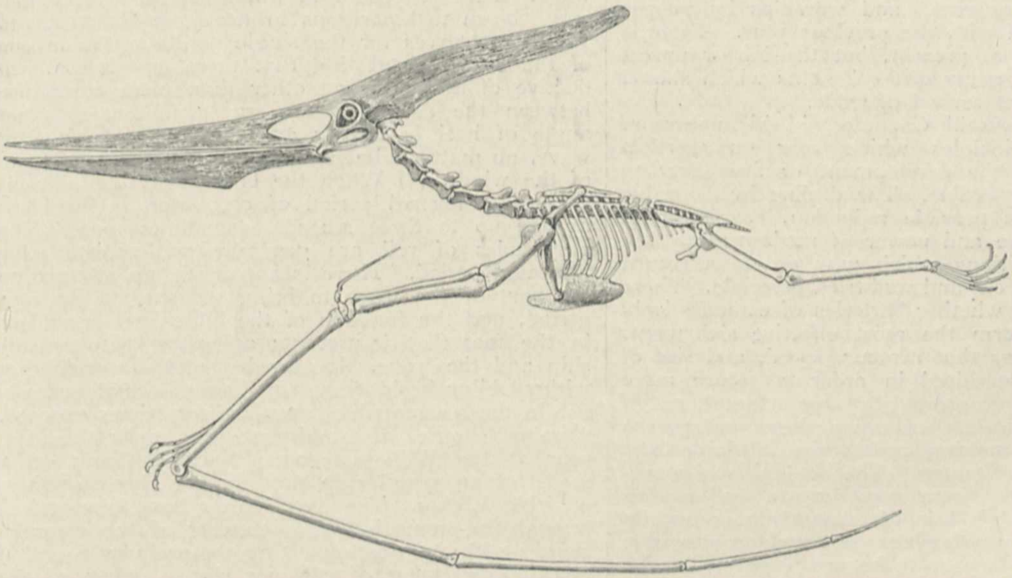
A. S. E. ACKERMANN.

THE FLYING REPTILES OF THE CHALK PERIOD.[1]

IN the remarkable collection of fossil vertebrates obtained by the late Prof. O. C. Marsh for the Peabody Museum of Yale University, there are many groups of which he only published preliminary notices. Among these the toothless Pterodactyls, which he was the first to discover in the chalk of Kansas, are specially deserving of attention. During the past ten years they have been studied in detail by Dr. George F. Eaton, who has now completed his researches and published a beautifully illustrated memoir, which will be welcomed by palæontologists. So long ago as 1904 Dr. Eaton prepared for the St. Louis Exposition a model of the skeleton of Pteranodon, of which a copy was subsequently given to the British Museum (Natural History), where it is exhibited in the Gallery of Reptiles. In his new work he now reviews the whole of the material which forms the basis of this restoration (shown in the accompanying figure), and his concise descriptions are illustrated not only by admirable photographs of the fossils themselves, but also by explanatory sketches of several of the most important parts.

Dr. Eaton is, indeed, to be congratulated on the clearness with which his facts and conclusions are presented, and he displays commendable caution in his references to crushed and distorted specimens. The bones are so delicate that nearly all have collapsed by pressure in the laminated chalky rock, and it is therefore often difficult to determine precisely their original shape.

The species of Pteranodon and its allies are the latest and most specialised flying reptiles, and so attain the greatest size. A nearly complete pair of wings mounted in the British Museum (Natural History) measures 18 ft. in span, and Dr. Eaton estimates that some specimens had a span of more than 22 ft. The adaptation of their bones to unusual mechanical needs is therefore of extreme interest. The well-known firm articulation of the scapula with a mass of fused thoracic vertebræ, for the support of the large wings, is now described in detail, and Dr. Eaton thinks there were not more than three separate dorsal vertebræ between this fused mass and the equally rigid sacrum. The tail is very short and small, and the slender hind limbs must have supported the postero-internal borders of the wing-membranes.



Restoration of Pteranodon, Marsh; from the left side. For convenience of representation the right limbs are omitted.

The elongated jaws of Pteranodon itself are completely toothless, and Dr. Eaton observes that there is never an indication of vestigial tooth-sockets. The articulation for the mandible is obliquely ridged and grooved, so that the two branches would be thrust a little apart when the jaw opened, as in the pelican. It is therefore inferred that the animal was a fish-eater and had a small pouch below the mandible.

In two species, though apparently not in a third, the supraoccipital crest is enormously extended, and would probably serve for the origin of very large temporal muscles giving great snapping power to the jaws. Even for such a purpose the crest appears to be sometimes too large, but Dr. Eaton concludes that it could scarcely be needed as a counterpoise to the long jaws, because "the form of the cervical vertebræ indicates a strong musculature of the upper part of the neck." He alludes to "the general theory that growth along certain lines may be initiated through the exercise of one function, while further development is dependent upon another totally distinct function." The crest may be an illustration of the so-called momentum in evolution.

It will be remembered that many years ago the late Prof. H. G. Seeley devoted much attention to the fragmentary remains of these gigantic specialised Pterodactyls found in the Cambridge greensand, and attained great success in interpreting them. The new work on the better-preserved specimens of Pteranodon from the North American chalk will excite renewed interest in the corresponding English fossils, and facilitate more exact studies of them.

A. S. W.

[1] "Osteology of Pteranodon." By Dr. G. F. Eaton. Pp. 38+xxxi plates. Memoirs of the Connecticut Academy of Arts and Sciences, vol. ii. (New Haven, Connecticut: [Published under the auspices of the Yale University, 1910.)

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual meeting of the Institution of Naval Architects opened on Wednesday, March 27, at the Royal Society of Arts, and extended over Thursday and Friday. The annual gold medal of the institution was presented to Prof. E. G. Coker for his paper on the determination of stresses by the photo-elastic method. Premiums were also awarded to Mr. C. E. Inglis and Mr. J. Montgomerie for papers read at the last spring meeting. The first award of a scholarship of 200*l.* per annum from the 1851 Exhibition Commissioners has been made to Mr. Arthur Cannon on the recommendation of the council of the institution. Mr. Cannon is pursuing a course of research work at Glasgow University in problems connected with the rolling of ships, and read a preliminary paper at this meeting on the effect of an internal free fluid upon the initial stability.

The president (the Marquis of Bristol) delivered an address in which he directed attention to the record in shipbuilding achieved during the past year. Merchant shipping launched in the United Kingdom advanced by 58 per cent., and warships by 71 per cent., as compared with the previous year. There is no lack of orders at present, but the labour unrest threatens to arrest many of the benefits which should follow on the recent revival of trade.

Admiral Sir Reginald Custance, in his paper on some military principles which bear on warship design, advocated the development of fire effect to the fullest extent possible. The decline in the value of armour and its possible reduction, coupled with the increased range and power of modern guns, are the changed conditions which may enable a return to be made to this old and well-tried principle. There is reason to doubt whether batteries of comparatively few large guns form the most effective armament. The admiral's views that armour, speed, and size of guns should be sacrificed in order to secure more guns were strongly contested by several speakers.

A paper on the law of comparison for surface friction and eddy-making resistances in fluids was read by Dr. T. E. Stanton. The prediction of wave-making resistance from experiments on models according to Froude's law of comparison is usually carefully treated by authorities on naval architecture, but there does not appear to be any suggestion of a similar treatment of the surface friction and eddy-making problem. Prof. Osborne Reynolds showed nearly thirty years ago that, in two pipes in which the lengths, diameters, and surface irregularities were in a given constant ratio to each other, if the velocities were made in the inverse of this ratio, the total frictional force was the same for each pipe. Lord Rayleigh has shown that, in cases where there is no resistance due to surface waves and the velocity is not high enough to produce cavitation, the resistance per unit area can be expressed by

$$R = \tfrac{1}{2}\rho V^2 k,$$

where k is an expression depending solely on $\rho \frac{vl}{\mu}$, μ being the coefficient of viscosity of the fluid and ρ its density. This law of comparison applies equally well to cases in which the resistance is made up partly of surface friction and partly of eddy making. Experimental verifications of the truth of this relation have been obtained at the National Physical Laboratory in two cases, viz., the determination of the frictional resistance of two different fluids (air and water) on the same surface, and the total resistance in water of models of a dirigible balloon to different scales. The latter tests are of particular interest. Two models of the same dirigible to different scales were towed in the experimental tank and their resistances measured. If the law of comparison holds, their resistances will be equal for the same value of vl, and this was found to be the case very closely. It thus becomes possible to estimate the resistance in air of a dirigible balloon by experiments in which a model is towed under water. Obviously the same method is applicable to torpedoes and submarines.

In the course of the last seven years considerable data have been collected regarding the rolling of Irish lightships. The results were summarised in a paper read by Messrs. George Idle and G. S. Baker. (*a*) The greatest rolling amplitudes are attained by the old ships, wooden or composite, having double bilge logs. These ships have generally small initial stability and a low metacentre, and show that the metacentric height does not by itself give any indication of the ship's probable behaviour in a heavy sea. (*b*) Large amplitudes are reached when the sea is breaking or confused and when the waves are advancing on the bows or quarters. Maximum amplitudes have been recorded when the ship has been nearly head to the advancing wave. The differences in amplitude of "head to" and "beam to" positions in heavy swells averaged 16 to 20 degrees for the single oscillation in favour of the latter, suggesting that there are causes productive of heavy rolling other than mere assonance between the ship and the wave. (*c*) The greatest angle of heel is always away from the advancing wave, no matter what may be the direction and force of the wind. (*d*) When the bilge keels are efficient the ship's normal period of oscillation is increased by one up to three seconds, sometimes more. The amplitudes of roll are generally moderate in this increased period. There is apparently an attempt on the part of the wave to bring the ship to its own period, and the function of the bilge keel is evident in the fact that it prevents assonance between the ship and the wave. It may be safely asserted that without bilge keels these small vessels could scarcely live in the seas to which they are sometimes exposed. A valuable series of experiments was undertaken last year at the William Froude National Tank on a model of an actual ship built for the Commissioners of Irish Lights. The experiments have been taken beyond the immediate requirements of the commissioners with the view of testing the ordinary equation for the decrement of roll per single swing of the ship, viz.:

$$-\delta\theta = a\theta + b\theta^2,$$

θ being the mean angle of swing port and starboard, and a and b coefficients which depend, the former on wave-making resistance and the latter on friction and head resistance. The results show discrepancies, and that there should probably be a term in θ^3 if the bilge keel is sufficiently near the water line.

The propulsion of modern vessels is developing along various lines, viz. internal-combustion engines, the steam turbine with speed-reduction appliances interposed between the turbines and the propeller, and in steam generation oil fuel finds many advocates. Papers on the Diesel-engined sea-going vessel *Selandia* and on gas power for ship propulsion were read respectively by Messrs. W. I. Knudson and A. C. Holzapfel, and Prof. J. H. Biles read a paper on the geared turbine Channel steamers, *Normannia* and *Hautonia*, in which the relative merits are discussed of mechanical gearing, electrical transmission, and hydraulic transmission for speed reduction between the turbine and the propeller shafts. The maximum efficiency of electrical transmission is about 90 per cent.; this method may be useful in cases where a great range of speed at high efficiency would be advantageous. Dr. Föttinger's system of hydraulic transmission gives an efficiency of about 90 per cent. at full speed. Both electrical and hydraulic systems admit of very large powers astern without separate prime movers. Helical gears with machine-cut teeth (made by Messrs. Parsons) were fitted to the steamers forming the subject of the paper. The loss in this gearing amounts to 1·5 per cent. only. There is practically no noise; a slight whistling sound can be heard by listening carefully when in the passenger quarters. There are no vibrations or trepidations. Sir Charles Parsons stated that most of the 1·5 per cent. waste occurred in the pinion bearings. There is no wear in the teeth, the oil film apparently being preserved unbroken. Dr. Föttinger raised the point of the limit of power which could be transmitted; his hydraulic gear was being fitted for very large powers. Mechanical gearing has been used for comparatively low powers up to the present, but no doubt can be developed to a much greater extent.

The discussion of the previous day on Mr. W. I. Knudson's paper on the *Selandia* provoked further comments on the Diesel engine from speakers in the discussion on Prof Bile's paper. The height of Diesel engines for a warship would be much greater than that of geared turbines; with the oil engines the most vulnerable parts of the machinery might be above the water line. The *Selandia* was reported at the meeting to be making good progress on her first voyage, and was passing through the Red Sea at above eleven knots.

In all seventeen papers were read and discussed at the meeting; the limitations of space have forbidden reference being made here to other than the more important papers.

THE INTERNATIONAL SMOKE ABATEMENT EXHIBITION.

THE remarkably clear atmosphere which has been observed in many industrial centres during the coal strike has afforded an excellent object-lesson in smoke abatement. It should emphasise the desirability of making these conditions permanent. That the removal of smoke comes well within the range of practical achievement has been amply demonstrated by the International Smoke Abatement Exhibition which has just been held under the auspices of the London Coal Smoke Abatement Society. In the official catalogue of the exhibition we find references not only to the exhibits of smoke-saving and smoke-preventing appliances, but to practical demonstrations of their use. The exhibition has further provided opportunity for a series of excellent lectures and addresses by well-known authorities, which include men of science, engineers, and manufacturers of English, German, and American nationality.

The exhibits may be divided into two categories, those which are devised for burning coal or partially coked material smokelessly, and those which replace the solid fuel by oil, gas, or electricity.

Anyone who may have watched the cookery demonstrations with gas cookers or observed the great improvement in the appearance of the various gas fires, or examined the electrical heating apparatus for domestic use, must have been impressed with the great advantage in cleanliness, convenience, and efficiency which these methods of heating possess over the coal fire. Indeed, it is impossible not to carry away the conviction that in the use of gas and electricity for heating and cooking, lies our future hope of salvation from the smoke fiend. The chief obstacle at present is their cost. Yet in spite of the high price of gas as compared with coal of the same calorific value, it is interesting to learn that during the last ten years there has been an increase of nearly two million gas cookers in the United Kingdom, whilst the total number of gas heating and cooking appliances installed by the London gas companies in 1910 reached 1,300,000.

This is a matter of considerable importance when it is remembered that the domestic hearth not only turns out by far the greater proportion of soot on the coal burnt, but soot of that particularly obnoxious quality which, by its high content of tar, is the most adhesive and permanent.

We have not space to refer to the numerous papers read at the conference, but must refer our readers to the small volume which has been issued by the Coal Smoke Abatement Society, 25 Victoria Street, Westminster, price 2*s*. 6*d*., which is well worth perusal by those who are interested in the various phases of the smoke question.

The papers may be divided into those dealing with (1) the causes, (2) the cure, and (3) the effects of smoke. Among the last, valuable information was contributed by Sir A. Church and Mr. N. Heaton on the important subject of the disintegration of building stone and the destruction of mural decoration by atmospheric sulphuric acid arising from burning coal, and experimental evidence showed that the stonework of ancient historic buildings was being slowly corroded. Dr. Rideal, who dealt with the effects on metal work, found that the rust on a roof girder of Charing Cross Station which collapsed in 1905 contained 4·25 per cent. of sulphuric acid, equal to nearly 9 per cent. of ferrous sulphate. The effects on vegetation are even more disastrous, and striking experimental results were recorded by Mr. W. J. Bean, assistant curator of Kew Gardens, and Mr. A. G. Ruston, of the Agricultural Department of the University of Leeds. The effects on health were discussed by Mr. W. B. Smith, chairman of the Air Purification Committee of the Glasgow Corporation, who gave statistics proving the high mortality from bronchial diseases during town fogs.

Though there has been some repetition of old arguments, opinions, and facts, these are subjects which cannot be too frequently dinned into the ears of an indifferent public in the hope that an echo of them may ultimately reach the local authorities and rouse them to a sense of their duty.

It is satisfactory, however, to learn from Mr. Lempfert, of the Meteorological Office, and Mr. J. B. C. Kershaw that matters are slowly improving. The number of hours of bright sunshine in the year in industrial centres, compared with certain country places, has steadily increased, showing that either the country stations are making more smoke or the towns less. The author of the paper, Mr. Lempfert, takes the latter and more sanguine view. He makes the significant remark that "the great difference between the figures for winter and those for summer suggests that domestic smoke rather than factory smoke is mainly responsible for the loss of sunshine." Now legislation in this country has not yet ventured to invade the sanctity of the domestic hearth, yet it is proved beyond question that it is the worst offender. Mr. Nicholson, smoke inspector for Sheffield, asks, with perfect justification, "Why should our domestic fireplaces be allowed to create an unnecessary nuisance any more than any other fireplace or furnace?" The answer is: provide cheap gas and electricity. The splendid combined exhibit of the gas companies and of the London electric supply and other manufacturers of electric appliances leaves little to be desired in the apparatus designed to utilise these two forms of energy.

Though we may yet have to wait a little time for cheaper gas and electricity, there is no doubt that much more might be done by the authorities to mitigate the smoke nuisance. We have only to consider the fact that not more than 10 per cent of the local authorities in the United Kingdom administer the law against smoke, and not more than twenty-five authorities have special smoke inspectors.

In conclusion, a word of acknowledgment is due to the London Coal Smoke Abatement Society and the Smoke Abatement League of Great Britain for their praiseworthy and persistent efforts to enlighten the British public on the methods available for the economic and cleanly utilisation of fuel.

J. B. C.

THE SURVEY OF EGYPT.[1]

WHERE the region is not too large there is a certain convenience in treating the various branches of study relating to the earth's surface in a single organisation, and in Egypt this arrangement has given good results. The report of the Survey Department on the work done in 1910 has recently appeared, and in the same way as in former years geodetic triangulation and precise levelling furnish the primary control for topographical surveys, cadastral surveys, and to some extent for the geological survey, which has to cover a wider area than that which has been accurately mapped up to the present time.

Astronomical work at Helwan Observatory was carried on regularly, Reynolds's 30-inch reflector being used to expose 249 plates, principally on Halley's comet. The geodetic triangulation has been carried southwards, reconnaissance having reached Tema, about 450 kilometres south of Cairo, while angular measurements and latitude observations were completed as far as Etsa, about halfway. Precise levelling in the delta is nearly complete, and is being pushed on towards Aswan, up the Nile Valley, Assiut having been reached, and a branch line having been carried into the Fayum to the Birket Qurun. The gravity survey of the Nile Valley has been commenced, and observations were being made at a series of stations between Cairo and Khartoum. The magnetic survey of the Nile Valley up to Wadi Halfa was completed, and in 1911 its extension into the Sudan was to be undertaken. Topographical surveying added considerably to the material which is utilised for the publication of maps of the Nile Valley and Delta on 1 : 50,000 and 1 : 10,000, and completed the survey of Alexandria town on the scale of 1 : 1000, that of Cairo being also considerably advanced. The cadastral survey was occupied in the re-survey of Beheira Province, since the original survey was made without any controlling triangulation, and hence left much to be desired. In geology the department's labours were mainly directed to the Red Sea coast, and especially that part lying round about the petroleum region at the south end of the Gulf of Suez, where much accurate surveying, as well as triangulation, was carried out.

Besides the normal series of cadastral maps on the scale of 1 : 2500, and topographical maps on the scales of 1 : 10,000 and 1 : 50,000, others of the whole of Egypt on 1 : 250,000 are in hand and should soon be published. Their early appearance will be welcomed. The report shows clear evidence of a large amount of work carefully and scientifically controlled, and the report sets an example which might well be more generally followed in showing not only the progress made, but also the rate of work and the cost of work in every branch, as well as the accuracy attained.

H. G. L.

[1] A Report on the Work of the Survey Department in 1910. (Cairo, 1911.) Price £T10.

PROMOTION OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1911 of the Carnegie Institution at Washington has reached us, and is, as usual, full of evidences of unremitting activity in the encouragement of research in science.

The following list shows the departments of investigation to which the larger grants were made by the Trustees of the Institution and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research ...	7,336
Department of Economics and Sociology	2,000
Department of Experimental Evolution	6,747
Geophysical Laboratory	10,896
Department of Historical Research ...	4,700
Department of Marine Biology	6,596
Department of Meridian Astrometry ...	6,296
Nutrition Laboratory	6,076
Division of Publication	1,800
Solar Observatory	27,211
Department of Terrestrial Magnetism ...	18,902
	£98,560

Numerous minor grants were made amounting to 18,863*l.*, and the grants made to research associates for their investigations amounted to 4840*l.* Grants for publication authorised during the year amounted to 11,200*l.* During the year 1911 the income of the institution was 201,114*l.*, and the expenditure reached 134,320*l.*

The president of the institution, Dr. Robert S. Woodward, says in his *résumé* of the investigations of the year 1911 that it has been, on the whole, the most fruitful year on record for the various specially organised departments of research in the institution. Although some of these are not yet fully equipped, they are all so well organised and provided for that their energies may now be chiefly directed to the attainment of definite results.

Among the more salient aspects of the affairs and researches of the various great departments, the following may be mentioned.

The investigations of the Department of Botanical Research during the year have embraced, among others, studies of the evaporation, the increasing salinity, and the changes in vegetation following close after the receding shores of the Salton Sea; of the influences of temperature, rainfall, sunlight, soil-moisture, &c., on plant organisms; of the effects following transplantation from low to high altitudes and from arid to humid localities; of the variations in water and acid content of plants; of the chemical effects induced in plant tissue by light and heat; and of the physiological functions of leaves in plant life. One of the most interesting investigations under way during the year is that of Dr. Ellsworth Huntington, research associate of the department, on the secular variations of climate of the south-west desert area in recent geologic time. From this work it is believed that some of the salient fluctuations in climate during the past two or three thousand years may be clearly made out. Another noteworthy investigation of the year is that of the respiration of cacti, undertaken by Prof. H. M. Richards in collaboration with the department. This has developed the remarkable fact of a definite diurnal periodicity in the acid content of the sap of the cacti under observation.

One of the most promising investigations of the year in the Department of Experimental Evolution is that of the director in reference to the heredity of epileptics. Another investigation continued during the year, which involves prime utilitarian application, is that of Dr. Shull on the effects of self-fertilisation in maize, or Indian corn. His earlier conclusions, published in 1908, have been confirmed by the later studies. A striking result from the latter is that, other conditions being the same, the yield of cross-fertilised plants proved 50 per cent. greater than that of the self-fertilised plants. Observational and experimental work has been carried on also along many other lines. The total number of zoological individuals under study exceeded 2000, while the range of plants observed included nearly 500 species and upwards of 40,000 individuals.

Among the papers issuing from the Geophysical Laboratory is a noteworthy contribution to general physics, in which the scale of precise thermometry is extended by 1250° C. This extension was an essential incident to the studies of mineral fusion, crystallisation, &c., carried on in the laboratory, but it is of equal importance to other branches of physical research. Another noteworthy paper is a preliminary contribution to the long-standing question of the constitution of Portland cement. The complexity of this substance proves to be far greater than hitherto supposed, but its general characteristics have been determined, and the resources of the laboratory are adequate to complete the remaining quantitative details of the investigation. Of numerous investigations under way at the laboratory, attention may be directed to some preliminary studies of an active volcano, which indicate that the phenomena of vulcanism are within range of practicable determination, and that progress in this direction is only a question of time and adequate effort.

In the Department of Meridian Astronomy, the deductions of stellar positions and motions are proceeding expeditiously in the computing section of the department at the Dudley Observatory, so that the final catalogue, giving precise positions of all stars up to the seventh magnitude inclusive, may be expected to appear in due time. As often happens in such extensive scientific investigations, many by-products are arising of hardly less importance than the primary ends in view. One of these, deduced from the preliminary Star Catalogue, published by the institution about two years ago, shows the mean velocities relative to the solar system of stars of different spectral types. The values derived from the "proper motions" of the catalogue are in striking agreement with those derived for the same stars by Prof. W. W. Campbell from direct measurements of the motions of these stars in the line of sight. The remarkable result which is thus brought out from independent investigations is that the speed of a star through space increases with its age.

Although the construction and equipment of the Solar Observatory are still incomplete, the members of the staff are making rapid progress with their programmes of solar, stellar, and physical observation and of computation and deduction. Thus the attainment of tangible results proceeds along with the development and installation of equipment. The observatory has now, nearly fully equipped and in use, four highly effective telescopes: the Snow, horizontal, 30-in. reflector; the two tower-telescope refractors; and the 60-inch reflector mounted equatorially. The 150-ft. tower telescope, together with its auxiliary apparatus, constitutes the most important addition of the year in the way of equipment. Varied use of the 60-in. equatorial proves it to be alike effective in visual, photographic, and spectroscopic work. It is especially penetrating in its capacity to reveal the characteristics of globular star clusters and spiral nebulæ.

The magnetic survey of the globe undertaken by the Department of Terrestrial Magnetism is proceeding effectively on both land and sea. Observations of the magnetic elements of declination, dip, and intensity have been made at numerous points on the continents of Asia, Africa, Australia, Europe, South America, and on the Polynesian Islands; while the non-magnetic ship *Carnegie* has secured a large quantity of data of immediate practical utility to navigation, and of still greater importance, doubtless, in their relations to the general problem of terrestrial physics. During the year the *Carnegie* traversed upwards of 23,000 nautical miles, measuring magnetic declinations at 252 different points, and dip and intensity at 172 different points at sea. In addition to this work, corresponding complete determinations were made on land at seven ports, and intercomparisons of magnetic instruments were made at three ports.

Unexpectedly large errors have been found almost everywhere, except in the South Atlantic Ocean, in the best compass sailing charts now in use. This is especially the case in the Indian Ocean, for which some recently issued charts are in error as much as 4° to 6° in the "compass variations" assigned. To meet the pressing needs of mariners for more trustworthy charts, the data obtained by the *Carnegie* are promptly furnished to the hydrographic establishments of the world engaged in the publication of magnetic charts. It appears from the investigations of the department that the chief source of the errors in existing charts lies in a lack of knowledge of the secular variation of the magnetic elements. It is worthy of note, also, in this connection, that observations of atmospheric electricity and atmospheric refraction have been carried on during this voyage of the *Carnegie*. The importance of precise navigation in recent times gives special interest to the outstanding uncertainties due to atmospheric refraction.

THE ROAD: PAST, PRESENT AND FUTURE.[1]

The Present.

A GREAT improvement took place when Macadam and Telford brought the results of their study and their inventive powers to bear, giving a road well laid below and a crust of small angular stones, which when pressed down close produced an infinitely better road than had been known before. But it must be admitted that while they provided better materials for a good highway, their mode of completing it entailed upon the road user and his horse and vehicle a great deal of unpleasant road-making work, involving much temporary discomfort, and much wear and tear to animal and carriage. The road user had to apply his vehicle to roller work, to force the stones into a closely packed surface. When completed it was a good road for the traffic of the day, but oh! it was trying work when the road user's vehicle not only conveyed his passengers or his goods, but was compelled to act the part of a road roller.

A great change took place when the heavy steam roller was introduced, which in one operation pushed the stones down into position. It afforded a blessed relief to those who used the roads with horses. But though advantageous in saving the road user and

[1] From a discourse delivered at the Royal Institution on Friday, February 16, by the Right Hon. Sir John H. A. Macdonald, K.C.B., F.R.S. Exigencies of space prevent what was said on the Past being given.—Ed.

his horse and carriage, and more expeditiously completing the new surface, it was not possible to provide a closely fitted road, which should have its interstices filled up by the chip and grit from the stones themselves, and which was an essential desideratum according to the Macadam theory. His principle was that no water should enter the surface of the road or penetrate beneath the crust. To keep water out of the road was one of the most essential points, if it was to be efficient. He strongly condemned any insertion of loose material into the interstices of the metal, or allowing water to enter between the stones of the crust. These maxims of Macadam came to be disregarded when steam rolling was introduced. When rolling was to be done in one operation, a device had to be resorted to, that the spaces between the stones might be closed by added packing, and this has been done by making what can only be described as a soup of dirt and water and pouring it upon the stones and brushing and rolling this liquid mud into the crust of the road. The road thus when opened for use is crusted with a coating of stones, the only binding of which is water thickened with dirt, or perhaps dirt diluted with water is the proper description. The result is that it can never be a good road in wet weather, and can never be a good road in dry weather. As long as it is in a slightly damp state, and not subjected to severe wet weather or long-continued drought, it may be a fairly good road. In wet weather water can get in where it has come out, reproducing the mud soup, and the traffic squeezes it up and out of the road. In dry weather, the binding being reduced in bulk and loosened by the evaporation of the moisture which gave the inserted dirt some cohesion, the stones move and are picked out of the surface, and so holes are left for the water to lodge in the dirt below when again rain begins to fall. What would Macadam say, if he could visit the scene of his scientific labours, to hear the phrase "water binding" used to describe the means employed for consolidating the crust. To call a water-formed road a macadamised road is a contradiction in terms. His emphatic declaration was: "Every road is to be made of broken stones, without mixture of earth, clay, chalk, or any other matter that will imbibe water."

But further, the road roller has not in another aspect proved to be an unmixed blessing. For it is not uncommon to see that its use has developed another evil. The heavy road roller coming on to a layer of stones, surrounded with liquid and therefore non-resisting mud, and pressing down the stones by its weight, necessarily must move the water and the dirt in suspension, otherwise the stones would not go close together. The liquid is therefore squeezed out of the way, and as the great width of the roller prevents its escape sideways, except at the edges, it must go forwards, and (water being practically incompressible) forces the water and the dirt and the stones in front upwards, forming a ridge in front. The roller advances, and when it cannot force the ridge farther forward, it then mounts it and descends in front, and so *da capo*, with the consequence that the road becomes a series of ridges and furrows, and when drying up resembles a mackerel's side, a series of dark-toned wet hollows and light-toned dry mounds. No worse state of matters for the traveller and his vehicle, or for durability of the road surface, can be conceived.

The Future.

What is the road of the future to be? It is a question which all who are associated with the management of roads have come to see calls imperatively for an answer. The problem is to find the best mode by which a road can be constructed, which will not have its surface broken by traffic, and will make transit easier both for passengers and goods, and shall neither form puddle holes nor exude mud to clog the vehicles and to form thick dust when the weather is dry; in short, that there shall be no loose material from the road, except the small quantity caused by surface wear, which it is found is but trifling when a sound crust has been rolled in. That such a road can be laid anyone may see by paying a visit to the Thames Embankment, the traffic on which was small formerly, the road being shunned as one of the worst in the country, but which is now used by an enormous number of vehicles, often as many as 1600 in an hour. It will be seen there that water on the surface dries off very quickly, there being no mass of mud to hold it, and that in the driest weather there is practically no dust. No watering is done during the day, the surface receiving one washing during the night, because of the horse traffic. But there is no need for the use of water carts by day. Even during the long drought of 1911 there was no watering, yet there was no appreciable dust.

The necessity for the development of road improvement as a matter of national concern is now recognised, and this has led to the establishment of the Road Board, as a Government department, to the charge of which the money raised by taxation of motor vehicles and motor fuel is handed over to be administered in aid of road improvement.

The Board encourages road improvement by giving grants in aid to those road authorities who undertake works of improvement in their districts. The Board has also been conducting, and will continue to conduct through their engineer and technical advisers, experiments, both in the laboratory and on the road itself.

I shall conclude by directing your attention to some of the results of recent experiments, by which I think you will see that it has been possible for the Board with the aid of its staff, and the experience of numerous surveyors who have been experimenting for many years, to obtain valuable and practical information, as regards the choice of material, its manipulation, its proportions, and the mode of laying it, which may ensure that good roads can be made, roads which will keep their surface sound for twice as long as the water-bound macadam road, and will not become uneven and break into holes, which was the fate of all the roads of the past.

The question: "What shall be the weight-bearing crust?" is one of vast importance, and this is engaging the attention of the advisers to the Road Board. I do not intend to dogmatise on the subject, but only to show you what steps of progress are being made, what has already been consummated in the production of roads which are to the old water-bound macadam what the genuine macadam was to the old track of foot-deep mud and bulky stones. One thing is now universally recognised, that the road of the future shall be a truly bound road, in which, whatever kind of stone is used—a matter into which there is not time to enter—that stone shall be held together by some pitchy or bituminous material, so that it shall be indeed a crust and not something which has no real cohesion, and into which Macadam's enemy, the water, can make its way whenever water falls. That this result has been attained in a practical way is manifest from the pieces of road crust cut out after they have been under traffic for long periods.

Roads formed as regards the crust in this way are now common. Many can be seen in Kent and other counties near London, and stretches are being laid throughout the kingdom. Great success was attained by many surveyors, and notably at an early date by Mr. Hooley, of Nottingham, in putting together road crusts with the aid of tarry components substituted for mud binding.

I have probably said enough to show that a good road, which shall keep smooth, be impervious to water, and not tend to disintegrate, is now an accomplished fact, and I only need to add that the cost, taken over a series of years, will not be more—indeed there is good ground to believe it will be less—than that of a road as it has been constructed in the past.

One question remains—will it not be well to endeavour to provide an elastic skin or carpet to lie between the vehicle and the bearing crust? The laboratory experiments made seem to indicate that this will be accomplished. Research has been made with pitch and with bitumen, and the conclusion has been reached that pitch will not give satisfactory results, but bitumen will do so. A stick of pitchy material has very little resiliency when subjected to strain. A bitumen stick of the same size is capable of being twisted without fracture, and when freed slowly resumes its shape.

It is expected that with such material laid on the top of the main road crust and integrated with it a valuable road protection will be supplied, so that the road crust will be practically permanent, the upper protecting sheet being remade up and relaid as required.

For the carpet or topping, the case is somewhat different from the crust. Here strength is not of so much importance as the elastic and silencing qualities, and the freedom from liability to produce any dust in summer or mud in winter. Another requirement which is very difficult to meet in this transition age is that of giving a surface good for motor and mechanical transport, and which will not be slippery, and will afford good foothold for horses. The carpet must be a compromise; it must not be as hard as motorists would wish for, but just so hard that it will wear a little and yet be cheap and easy to maintain.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Science announces that the Massachusetts Institute of Technology has received from a donor whose name for the present is anonymous a gift of 500,000*l.* for the erection of the buildings on its new site.

SINCE our last issue, Lord Haldane, chairman of the Royal Commission on University Education in London, has received a promise of 50,000*l.* towards the purchase of the site on the Duke of Bedford's estate north of the British Museum for London University. This brings the total amount subscribed for a new site and Senate house for the University to 355,000*l.*

THE new buildings of the Spinning Section of the Textile Department of the University of Leeds will be opened by the Master of the Clothworkers' Company on Friday, April 26. The ceremony, at which the chancellor of the University (the Duke of Devonshire) will be present, will take place in the hall of the University. The Clothworkers' Company, whose liberality has made the new extension possible, will be represented by the Master (Mr. F. G. Fitch), the Warden (Mr. G. H. Nussey), Mr. A. W. Snow, Sir Owen Roberts, Sir Swire Smith, Mr. William Latham, K.C., and the Right Hon. G. W. Balfour.

A PRIZE fellowship of 120*l.* was offered by the Federation of University Women in December last, open to women who have been engaged during a number of years in research, the results of which have been published. Thirteen applications were received, investigations in zoology, geology, physiology, botany, physics, history, Oriental religions, English literature, French literature, and philosophy being submitted. The fellowship has been awarded to Miss C. E. Spurgeon, docteur de l'Université de Paris, lecturer in English literature at Bedford College, London. Miss Spurgeon's published work deals chiefly with mysticism in poetry and with Chaucer criticism.

THE annual report on the work and progress of University College, London, has just been issued. The total number of students during the session 1910–11 was 1600; of this number there were in the faculty of science 197 undergraduate and non-matriculated students, and 90 postgraduate and research students. The report contains a *résumé* of the chief activities of the year, together with appendices showing the list of original papers and other publications recording the results of investigations carried on in the college. There is also a summary of the important developments of the year. Among these, the two most noteworthy are to be found in the progress made in the scheme for new chemical laboratories, due especially to the gift by Sir Ralph C. Forster of 30,000*l.* towards the buildings, and in the anonymous benefaction of 30,000*l.* primarily for the building of the new School of Architecture. The report shows that a sum of about 10,000*l.* is still required to complete the new chemical laboratories.

IN an address at Boston on March 6, Dr. R. C. Maclaurin, president of the Massachusetts Institute of Technology, said nearly everyone recognises to-day the power and might of science, and nearly everyone pays it at least the homage of the lips. He reviewed some of the controversies that marked the foundation of the Massachusetts Institute of Technology. It was attacked only a half-century ago on the ground that science is antagonistic to humanity. The idea was that science was unsuited to be an instrument of education because it dealt with nature rather than with men. This limited idea can find little favour to-day, when science is seen to be human to the core. Even when it deals with nature it deals with man's views of nature; but, apart from this, half a century of its sway has displayed to the world something of the immensity of its power to make for human betterment. "Science in the service of man," continued Dr. Maclaurin, "is indeed the watchword of modern progress, and men and women who could serve their fellows in the future will find themselves handicapped unless they have learned to serve with the method and in the spirit of science."

THE recently published report of the Board of Education for the year 1910–11 (Cd. 6116) gives much useful information concerning the number of efficient secondary schools in England and of pupils in them. The total number of schools regarded as eligible for grant during 1910–11 was 862, as compared with 841 during 1909–10. In these schools there were, on January 31, 1911, 79,506 boys and 66,378 girls, as compared with 76,699 boys and 64,450 girls in 1910. There were 96 other schools recognised by the Board as efficient during 1910–11, though they were not on the grant list. In these schools on the date given above there were 9946 boys and 7666 girls. So far as the number of pupils in public elementary schools is concerned, the report shows that in 1910–11 the number under five continued to fall, as in previous years, and, in addition, during this year there was a decrease of 8118 in the number of pupils over twelve;

the number between five and twelve rose by 32,169, and the net decrease of pupils of all ages was 7482. During 1910–11 the average number on the registers decreased by 0·11 per cent., the average attendance increased by 0·09 per cent., and the percentage of regularity rose to 89·15.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 28.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. G. J. **Burch**: A confusion test for colour blindness. A sheet of perforated zinc is fixed in the focal plane of a convex lens of about eight diopters, through which the observer looks. On a card six in. or so farther off is painted a design in confusion colours, *e.g.* red and blue letters on a dark-green ground. The red-blind can distinguish the blue letters but not the red, though these are far more conspicuous to the normal. The letters being out of focus, brush marks are invisible, and new designs can be easily drawn. Other colours are: Geranium red with French grey; emerald green with yellow ochre; lilac with blue—this last being a test also for the green-blind.—Clifford **Dobell**: The systematic position of the Spirochæts. The paper is a brief summary of certain results obtained from a detailed study of the morphology of a large number of Spirochæts and related organisms. It is maintained that the Spirochæts cannot be regarded as Protozoa, but that they must be classified among the Schizophyta, and that in the latter group they must be placed among the Bacteria and not among the Cyanophyceæ.—E. C. **Snow**: The influence of selection and assortative mating on the ancestral and fraternal correlations of a Mendelian population. Using the simple hypothesis of Mendel, the author investigates by analytical methods the numerical effect on the ancestral and fraternal correlations of dealing with samples (*a*) which are not true random samples of the general population and which mate with no sexual selection; (*b*) which are perfectly random samples of the general population but mate with certain intensity of assortative mating; (*c*) which are selected samples showing assortative mating. So far as *numerical* results are concerned, the investigation supports the view that the Mendelian hypothesis can be employed to give confirmation to results which have at first sight appeared paradoxical (*e.g.* the closeness of the resemblance between first cousins) and to give a rough indication of the probable results in cases for which actual statistical data are inadequate (*e.g.* the inquiry into the effects on the offspring of inbreeding of various degrees).—T. **Lewis** and M. D. D. **Gilder**: The human electrocardiogram; a preliminary investigation of young male adults, to form a basis of pathological study.—C. **Revis**: The production of variation in the physiological activity of *Bacillus coli* by the use of malachite-green. *Bacillus coli* can be trained to grow in nutrient broth containing malachite-green. By gradually increasing the percentage of the malachite-green the organisms will develop readily in presence of 0·10 per cent. In most cases the organism at the same time undergoes a profound change in its physiological activity towards sugars and polyhydric alcohols, acid only being produced in certain of these, from which the organism originally produced both acid and gas, the power of gas formation being permanently lost. In one instance this change in physiological activity was accompanied by equally profound morphological and cultural changes, the resultant organism being quite different from that from which it had been produced. The change brought about by malachite-green indicates a connection between the typhoid and coli groups and the possibility of development of organisms of the one into those of the other.—Muriel **Robertson**: Notes on some flagellate infections found in certain Hemiptera in Uganda.—Muriel **Robertson**: Notes on certain aspects of the development of *T. gambiense* in *Glossina palpalis*.—Dr. H. L. **Duke**: Antelopes and their relation to trypanosomiasis.—F. P. **Knowlton** and Prof. E. H. **Starling**: The nature of pancreatic diabetes (preliminary communication).

Zoological Society, March 19.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—E. W. **Shann**: Observations on some Alcyonaria from Singapore, with a brief discussion on the classification of the family Nephthyidæ. All the specimens had been obtained in shallow water, from low water-mark to a depth of about 10 fathoms, and of the eleven species dealt with in this paper, representing six different families, four were described as new.—Sir George H. **Kenrick**: A list of moths of the family Pyralidæ collected by Felix B. Pratt and Charles B. Pratt in Dutch New Guinea in 1909–10, with descriptions of new species.—T. H. **Withers**: Some early fossil cirripedes of the genus Scalpellum. Attention was directed to the form of the carina of the geologically older species of Scalpellum, and it was shown that the earliest forms known resembled more closely the carina of Pollicipes, from which Scalpellum is considered to be derived.

Royal Meteorological Society, March 20.—Dr. H. N. Dickson, president, in the chair.—Prof. Otto **Pettersson**: The connection between hydrographical and meteorological phenomena. Experiments carried on during the last four years at Bornoe, in Sweden, have shown that the inflow of the undercurrent from the North Sea into the Kattegat—which brings the herring shoals in winter to the Swedish coast—is oscillatory, the boundary surface of the deep water rising and sinking from 50 to 80 ft. about twice a month. The phenomenon is governed by the moon's declination and proximity to the earth. From astronomical data, Prof. Pettersson concludes that the influence both of the sun and of the moon upon the waters of the ocean in winter about the time of the solstice must have been greater 600 to 700 years ago than at the present time. This must have caused a more intense circulation, of which we have conclusive evidence in the fact that the migrations of the herring—which now only reach as far as to the Kattegat—in those centuries extended into the Baltic. The hypothesis first proposed by A. W. Ljungman in 1879 that the periodicity of the great secular herring fishery of Bohusland should agree with that of the sun-spots is by no means incompatible with the phenomena here described, since the fourteenth century is noted in Chinese annals as an epoch of maximum solar activity, and since the sun-spot frequency curve of Wolfer can be reconstructed by harmonic analysis, using the moon's apsides and nodal period as the basis of the analysis.

Royal Microscopical Society, March 20.—Mr. E. Heron-Allen, vice-president, in the chair.—C. F. **Rousselet**: Four Rotifera from the Devil's Lake, a large brackish-water lake in North Dakota. The point of interest was that all four species lived in brackish water only. One, *Pedalion fennicum*, was first found in Finland; another was a new species, *Brachionus spatiosus*; the third, *Brachionus satanicus*, Rousselet, known only from this locality, and the fourth was *Asplanchna silvestrii*, Daday, ♂♀, showing dimorphism in the female.—F. **Enock**: Fairy flies and their hosts.

Manchester.

Literary and Philosophical Society, March 19.—Prof. F. E. Weiss, president, in the chair.—Prof. S. J. **Hickson**: Note on a specimen of a recent coral, *Endopachys grayi*, from the Persian Gulf. Three out of the four known specimens of this species were until quite recently in the possession of the Manchester Museum, but one has, however, been presented to the British Museum of Natural History. One specimen was reported as having been found in the China Sea. —C. E. **Stromeyer**: Note upon the surface ridges and hollows of tramway and railway lines.—R. F. **Gwyther**: The complete formal solution of the equations of stress in cartesian, and in cylindrical and spherical coordinates. The paper dealt with the stresses in materials, independently of any assumption as to their nature, and so applicable to all structural materials, such as iron, steel, and concrete, as well as to stresses of earth on retaining walls, and perhaps of grain in grain tins or bunkers. Most theoretical applications have been made to substances assumed to obey Hooke's law connecting stress and strain, and also applied to substances which are certainly not of that character. The method can be applied to the subject of geophysics.—Dr. H. G. A. **Hickling**: Variation of *Planorbis multiformis*. The shell exhibited every gradation from a perfectly flat type to one with a high spire. The mean type is represented by a large number of specimens, while the extreme types are scarce. The curve representing the various types is a simple variation curve, thus proving that all the forms belong to a single species. Great variation occurs in other characters of the shells, and these variations appear to be independent of one another.

Edinburgh.

Royal Society, March 4.—Prof. T. Hudson Beare, vice-president, in the chair.—Dr. J. W. **Evans**: The geometry of twin crystals. The paper contained a somewhat novel way of considering the mathematical relationships in twin crystals.—E. M. **Wedderburn**: Temperature observations in Loch Earn, with a further contribution to the hydrodynamical theory of temperature oscillations in lakes. With the help of some two dozen students of science in Edinburgh and Dundee, Mr. Wedderburn made a careful study of the simultaneous temperature variations at a number of selected stations along Loch Earn during August of last year. The oscillations of the temperature seiche could be clearly traced. At certain stations measurements of current were also made. A modified theory gave a formula for the period of the seiche which agreed within 5 per cent. of the observed period.—James **Russell**: Transverse induction changes in demagnetised and partially demagnetised iron in relation to the molecular theory of magnetism. Iron tubes were magnetised spirally by applied longitudinal and circular magnetic fields, and these were reduced by diminishing alternations until the tube was left in an apparently neutral condition. The æolotropy left in the material was proved by the *transverse* induction change produced by application of a given field. These transverse changes were compared with what was deduced from a special theory of molecular magnetism. The comparison was satisfactory.

March 18.—Dr. James Burgess, C.I.E., vice-president, in the chair.—Dr. W. T. **Gordon**: *Rhetinangium Arberi*, a new type of fossil stem from Pettycur. This new genus and species is important on account of its relationship to other forms. It resembles Heterangium in many points, but is most closely allied to Kidston's new genus, Stenomyelon. The new form seems to be a phyllogenetic link between the lower Pteridosperms as represented by Heterangium and the higher members of that group.—Dr. John **Aitken**: The sun as a fog-producer. It was noticed some years ago that at Falkirk fogs frequently began to form just at sunrise. Observations during the last four winters showed that when the wind was light and came from an impure direction (that is, from densely inhabited areas), and was damp, but not necessarily saturated, a fog invariably formed if the sun shone, but did not form if there was no sunshine; also that when the wind came from a pure direction, the sun had no fog-producing effect. Experiments were then made on vessels filled with various products of coal combustion, and the conclusion was come to that the fogs were caused by the action of the sun on the products of the sulphur in the coal, and also to the sunshine forming hydrogen peroxide in the air. In this way particles are formed which can condense vapour in unsaturated air. Radio-activity and the electric discharge had a similar action.

Paris.

Academy of Sciences, March 25.—M. F. Guyon in the chair.—Maurice **Hamy** and M. **Millochau**: The new star in the constellation of the Twins (see p. 121).—H. **Poincaré**: The diffraction of the Hertzian waves. Remarks on a dissertation by M. March, in which conclusions are drawn which are in contradiction to those previously published by M. Poincaré. It is shown that this difference is due to an error in the method employed in the approximation of an integral. —A. **Lacroix**: The deposits of corundum in Madagascar. These deposits result from the metamorphism of aluminous sediments under the influence of granite; their practical utilisation is doubtful owing to the discontinuous nature of the deposits.—W. **Kilian** and Ch. **Jacob**: The tectonic of the mountains situated between Mt. Blanc and the small St. Bernard.—M. Metchnikoff was elected a Foreign Associate in the place of the late Sir Joseph Dalton Hooker.—Fr. **Iniguez**: The new star, *Nova Geminorum*. Observations made at the Observatory of Madrid. The spectrum showed two superimposed spectra, one with bright lines of hydrogen, the other an absorption spectrum rich in lines in the neighbourhood of $H\gamma$.—Ch. **Platrier**: Contribution to a theorem on the integral equations of Fredholm of the third species.—Rodolphe **Soreau**: The graphical resolution of the trinomial equation with any exponents.—A. **Leduc**: The specific heats of vapours in the immediate neighbourhood of saturation. The theoretical investigation given is applied to the case of water.—Louis **Dunoyer**: New observations on the fluorescence of sodium vapour. Details are given of the special precautions taken to ensure the purity of the sodium employed. The fluorescence obtained was yellow, and examined spectroscopically was found to show only the D line. —A. **Cotton** and H. **Mouton**: Magnetic double refraction and chemical constitution.—Ed. **Chauvenet**: The hydrates of zirconyl chloride. Thermochemical data for the hydrates of zirconyl chloride.—M. **Dublancq-Laborde**: The existence of metamorphosed limestone blocks in the older tufa of Mount Pelée.—Pierre **Lesage**: The limits of germination of seeds submitted to the action of various solutions.—J. E. **Abelous** and E. **Bardier**: The mechanism of anaphylaxis.—Ch. **Gravier**: Some parasitic Crustacea arising from the second French Antarctic expedition.—Mieczyslaw **Oxner**: Experiments on memory and its nature in a marine fish, *Serranus scriba*. The proof has been obtained that this fish can clearly associate the sensation of feeding with the red colour of a cylinder in which the food was placed.—O. **Duboscq** and Ch. **Lebailly**: *Spirella canis*, a new genera and new species, a spirillum from the stomach of the dog.—Gabriel **Bertrand**, M. and Mme. **Rosenblatt**: Increase in the activity of the sucrase of Aspergillus in presence of various acids.—Pierre **Gérard**: The amount of potassium and sodium in the different organs of the dog.

CALCUTTA.

Asiatic Society of Bengal, March 6.—G. R. **Kaye**: Mediæval references to "Indian mathematics." This paper gives numerous references to so-called "Indian mathematics," &c., by Western mediæval authors—Arabic and European. Mahommed Vin Musa, Avicenna, Masùdi, "Omar-al-Khayyām," Leonardo Finbonacci, John of Holywood, Jordanus Saxo, Maximus Planudes, and many others have often been quoted as expositors of Hindu mathematics, and many of them actually themselves designate their arithmetic and the arithmetical notation they use as "Indian." But the "Indian" arithmetic they exhibit has practically nothing in common with the Hindu mathematical works of Aryabhati, Brahmagupta, Bhāskara, &c., and the "Indian" symbols they show are all of Arabic forms. We have, then, to choose between the exotic and the indigenous or orthodox Hindu exposition. The present author prefers to accept the Hindu works as really representative, and rejects the Western evidence where it does not agree with the Hindu evidence.—W. **Kirkpatrick**: Primitive exogamy and the caste system. The *Sirki Wálás*, or the reed-mat folk, "he that lives under a mat," are an aggregate of tribes of a Gipsy character distributed over the United Provinces. There are numerous branches of this nomadic race. The fact that none of these branches intermarry only points to their being endogamous sections of one original family. Each endogamous section is subdivided up into exogamous septs of occupational, ethnic, eponymous, and totemic origin. All these casteless people are gradually coming under the influence of the caste system. Caste in India, in whatever direction its evolution, is dominated by the *Jus Connubii*. The constant creation of separate connubial groups in modern Hinduism has its origin in the instinct which taught man to seek his bride from another camp, which goes back to marriage by capture, which is exogamy in its most primitive form.

BOOKS RECEIVED.

A Manual of Structural Botany. By Prof. H. H. Rusby. Pp. viii+248. (London: J. and A. Churchill.) 10*s.* 6*d.* net.

Bericht über die Tätigkeit des Königlich Preussichen Meteorologischen Instituts in Jahre 1911. Pp. 190. (Berlin: Behrend and Co.) 6 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Fünfte Lief. Pp. 161–320. Vierte Lief. Pp. 321–480. (Jena: G. Fischer.) Each 2.50 marks.

Handbuch der Morphologie der Wirbellosen Tiere. Edited by A. Lang. Zweiter Band, Erste Lief. (Jena: G. Fischer.)

The Kingdom of Man. By Sir E. Ray Lankester. New edition. Pp. x+114. (London: Watts and Co.) 6*d.*

A Geological Excursion Handbook for the Bristol District. By Prof. S. H. Reynolds. Pp. 224. (Bristol: J. W. Arrowsmith, Ltd.) 3*s.* 6*d.* net.

Wahrscheinlichkeitsrechnung. By O. Meissner. Pp. iv+64. (Leipzig and Berlin: B. G. Teubner.)

The Science of Hygiene. By W. C. C. Pakes. New edition, revised by Dr. A. T. Nankivell. Pp. xi+164. (London: Methuen and Co., Ltd.) 5*s.* net.

Elements of Hydrostatics. By G. W. Parker. Pp. viii+150. (London: Longmans and Co.) 2*s.* 6*d.*

Der Mythus von der Sintflut. By G. Gerland. Pp. v+124. (Bonn: A. Marcus and E. Weber.) 3 marks.

Junior Heat. By Dr. J. Satterly. Pp. viii+184. (London: W. B. Clive.) 2*s.*

On the Physiology of the Semicircular Canals and their Relation to Sea-sickness. By Dr. J. Byrne. Pp. ix+569. (New York: J. T. Dougherty; London: H. K. Lewis.) 12*s.* 6*d.* net.

Einführung in die höhere Mathematik für Studierende und zum Selbststudium. By Prof. H. von Mangoldt. Zweiter Band. Pp. xi+566. (Leipzig: S. Hirzel). 14.40 marks.

DIARY OF SOCIETIES.

THURSDAY, April 11.

MATHEMATICAL SOCIETY, at 5.30.—An Application of the Theory of Integral Equations to the Equation $\nabla^2 u + k^2 u = 0$: H. S. Carslaw.—On Mersenne's Numbers: A. Cunningham.

FRIDAY, April 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—The Genus Dosinia and its Subdivisions: A. J. Jukes-Browne, F.R.S.—On the Generic Name to be applied to the *Venus islandica*, Linn.: E. A. Smith.—Note on *Lapparia Parki*: H. Suter.—Characters of Three New Species of Fresh-water Shells from Uruguay; New Species of Limicolaria from British East Africa: H. B. Preston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Exminster Sewage-disposal Works: H. G. Hoskings.

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