THURSDAY, AUGUST 21, 1913.

ETHNOGRAPHY OF NORTHERN NIGERIA.

Hausa Superstitions and Customs: an Introduction to the Folklore and the Folk. By Major A. J. N. Tremearne. Pp. xv + 548 + plates + map. (London: John Bale, Sons, and Danielsson, Ltd., 1913.) Price 21*s.* net.

IN this book Major Tremearne has provided students of folklore with a feast of tales from Northern Nigeria, and it may be said at once that the material is arranged in such a way as to enable the reader to deduce from the tales themselves a very fair picture of the ethnography of the people amongst whom they were collected. The main portion of the book consists of one hundred stories, each of which is accompanied when necessary by a note on the local variants and on parallel tales in other parts of the world. The stories are preceded by a chapter in which they are analysed, and which contains all that can be deduced from them relative to the manners and customs, the mode of thought, and the beliefs of the Hausa, together with many explanatory passages drawn from the author's own experience and reading. They are followed by notes which explain separate words or incidents in each tale, the existence of each note in a particular story being indicated by a number inserted in the text. The book concludes with two short chapters, on tribal marks and on the Bori dance respectively.

The first, or analytical, section has been carefully prepared, and contains much material which will be of value to anthropologists at large. It can scarcely be studied apart from the tales themselves, and the serious student will find it necessary to read this section carefully both before and after studying the text of the legends. The great majority of the stories were obtained at Jemaan Daroro, in the Nassarawa Province, from five informants, two soldiers, two personal servants, and the head of the leather-workers, and the table of contents indicates the individual responsible for each.

A great feature of this collection is constituted by the number of stories in which animals figure as the chief characters, and, as might be expected, one is continually reminded of "Uncle Remus." The favourite character, however, is not "Brer Rabbit," but the spider (which plays also a very large part in Jamaican folklore). He is invariably shown as the epitome of greed and cunning, and though he sometimes comes to grief, he is generally successful in outwitting the other animals. A less frequent character, though more consistently successful in his trickery, is the jerboa, while the hyæna is the buffoon whose unintelligent greed nearly always lands him (or her) in difficulties. Here we have typified the general morality of the native as expressed in his folklore; cunning and wit are the passports to success, and the man who possesses them to a sufficient degree may be excused dishonesty, cruelty, and greed. The one unpardonable sin is stupidity, though disobedience to the wishes of parents is also usually visited with punishment. It is not, however, low cunning only that is held up for admiration; mental acuteness of a high order is also highly esteemed, and a certain number of stories occur which celebrate judgments of a Solomon-like order. The point lies rather in the fact that there seems little, if any, distinction in the native mind between the two varieties of cleverness.

Many of the stories have their counterparts in other regions of the world; we have our old friend the tar-baby, and a story of the equally familiar "open sesame" type; a cumulative tale, similar to that about the old woman and the pig, is also found, and a whole host of characters, such as many-headed giants, witches (who must be utterly destroyed even to the last drop of blood to prevent their resurrection), half-men (like the Japanese *Ippi*), and so forth.

Etiological tales are disappointingly few; but one interesting example explains the relative positions of the eye and eyebrow. In this is related a contest between a man called "You-are-wiser-than-the-king" and the ruler; the latter chases the former, both assuming a variety of shapes, until finally the king's adversary falls into the eye of an old woman and becomes the pupil, while the king transforms himself into the eyebrow to watch for the other to come out, and thus they remain.

One story, apparently told in all seriousness, is interesting as showing singular deficiency in mental arithmetic. A man dies leaving a fortune of 20,001 cowries. It falls to the lot of the king to divide this among three children, and he is at his wits' end to know how to divide the one cowrie. Finally, the aid of a wise man is called in, and he divides the inheritance piecemeal, finally leaving six cowries, of which he gives two to each and thus solves the extraordinarily difficult problem.

Especially worthy of remark is a very full account of the sign-language current among the Hausa, which is found in the first section of the book, and also the short account of the Bori dance, in which the performer becomes possessed by a definite spirit with a definite name and attributes. This dance is now forbidden.

The book contains a large number of illustra-

tions in half-tone and line. The photographs are of very unequal value, and it would have been better if the author had given some indication in cases where they had been retouched. The line-drawings are better, except those of the tribal marks, the value of which is impaired by over-reduction. The principal criticism, however, that may be brought against the illustrations as a whole is that they have very little organic connection with the text.

PHYSIOLOGICAL PATHOLOGY.

A Text-book of Pathology for Students of Medicine. By Dr. J. George Adami and Dr. John Macrae. Pp. x+759+plates. (London: Macmillan and Co., Ltd., 1912.) Price 25*s.* net.

THE appearance of a text-book of pathology which is intended for the use of medical students, and comprises so many of the admirable features of Prof. Adami's larger work, is a very welcome event. "The Principles of Pathology" has taken its place as the standard work on pathology in the English language, but a system of pathology occupying two large volumes is inevitably beyond the powers of the average student, who is obliged, within a limited space of time, to acquire a reasonable knowledge of the numerous subjects of the final examination. The full and detailed treatment which is accorded to the subject in the larger work is, moreover, unsuited to the student at the outset of his studies in pathology. In spite of the authors' claim that the new book is no mere epitome, we are glad to recognise in an abbreviated form many of the best features of the larger work. The articles on inflammation and on the general pathology of tumours are instances in point.

To the student who has received a sound training in the general principles of the biological sciences this book will make a direct appeal. To the medical student the study of pathology should form the natural sequence to the study of chemistry, of physics, of physiology, and anatomy. A work in pathology should be no mere catalogue of the morbid changes in various organs. The student who has been taught to base his views on conclusions to be drawn from experimental facts will find this method of teaching continued and exemplified in this text-book of pathology. The sections which deal with general pathology are written in a most attractive manner, and afford a delightful introduction to the subject. The portion of the work devoted to special pathology is of necessity somewhat brief. Such omissions as occur will, however, be readily filled by the knowledge derived from a practical experience of the subject.

The essential object of this work is, we imagine, to afford an introduction to the subject. This object has been successfully attained. To those who merely seek a compressed epitome of morbid anatomy this book is entirely unsuitable.

H. R. DEAN.

VEGETABLE ALKALOIDS.

The Plant Alkaloids. By Dr. T. A. Henry. Pp. vii+466. (London: J. and A. Churchill, 1913.) Price 18*s.* net.

THE alkaloids of plants have long offered a most interesting and attractive, if always difficult, field of research to both chemists and physiologists. The subtle chemistry of the vegetable cell evolves no objects more fascinating to study than these "vegetable alkalis," as Sertürner first termed them; bodies usually of highly complex chemical structure, and often of appalling potency in their physiological effects. Of the problems which they offer, one in particular—that of their chemical constitution—has received a large amount of attention during the last two or three decades, and much progress has been made with it. *How* much is perhaps scarcely realised until the results are collected and collated, as in the book under notice, in such fashion that a bird's-eye view of the whole field can be readily obtained. Then the reader notes that "alkaloids of unknown constitution" form only one group out of nine, and that group not a remarkably large one; whilst in the case of several members even of this group—for example, the aconites, colchicum, and ergot—knowledge of their structure is beginning to accumulate.

When, however, the chemical structure of an alkaloid has been elucidated, there yet remains a problem of great general importance, namely, how its chemical constitution is correlated with its action on the animal system. What is the deft arrangement of atoms which confers upon strychnine its tetanising action, convulsing all the muscles of the body; and what, on the other hand, is the arrangement in curare, a drug which paralyses the motor nerve endings without affecting the excitability of muscle? Many useful observations have been made on this question, but the difficulties are great, and progress slow. A comparatively simple case is quoted where two investigators, after studying the relation between the mydriatic action and the chemical constitution of the tropëines, were forced to the conclusion that no generalisation could be made which would explain all the results they obtained.

Another question which has been much debated is the mode of formation of the alkaloids in the plants. The view mostly favoured is that they,

or at least some of them, are decomposition-products of proteins, chlorophyll, and other complex substances. As regards their function in the plants, they have been variously considered as nutrient materials, protective substances, or end-products of metabolism, rendered harmless to the plant, and stored chiefly in special cells whence they are not readily re-absorbed into the active plant tissues.

On these and other general questions Dr. Henry touches, though but lightly, in the introduction to the work under review. It is rather a pity that more space was not given to this aspect of the subject: the one criticism which the book invites is that it is too much like a collection of extracts from the Journal of the Chemical Society. But it is a good collection, and includes the chief historical, chemical, physical, and physiological data relating to the numerous alkaloids dealt with; whilst in the case of those which have been successfully studied, a concise summary is given of the experimental evidence, and of the arguments founded on this evidence, which elucidate their structure and establish their accepted chemical formulæ. In particular, readers whose business or pleasure it is to study the less-known alkaloids will often be moved to call down a benediction on the head of the author.

C. SIMMONDS.

RECENT BOOKS ON PHYSICS.

(1) *Introductory Electricity and Magnetism.* By Carl W. Hansel. Pp. xv+373. (London: W. Heinemann, 1913.) Price 2*s.* 6*d.* net.

(2) *Mathematical Physics.* Vol. i. Electricity and Magnetism. By C. W. C. Barlow. Pp. vii+312. (London: W. B. Clive, 1913.) Price 4*s.* 6*d.*

(3) *La Matière: Sa Vie et ses Transformations.* By Prof. Louis Houllevigue. Préface de Ed. Bouty. Pp. xxxii+318. (Paris: Librairie Armand Colin, 1913.) Price 3.50 francs.

(4) *Dispersion und Absorption des Lichtes in ruhenden isotropen Körpern.* Theorie und ihre Folgerungen. By Dr. D. A. Goldhammer. Pp. vi+144. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 3.60 marks.

(5) *Cours de Physique Générale.* Leçons professées à la Faculté des Sciences de l'Université de Lille. By H. Ollivier. Tome Second. Thermodynamique et Etude de l'Energie Rayonnante. Pp. 295. (Paris: A. Hermann et Fils, 1913.) Price 10 francs.

(1) THIS book is intended for beginners, but covers the syllabus of the lower certificate examination of the Board of Education. The order of treatment adopted is:—magnetism, electrostatics, current electricity. Each branch is introduced by a simple qualitative account before the more advanced quantitative aspects are considered.

The treatment of the electrostatics is most lucid, and the author makes, and rightly, a special plea for more experimental work, performed by the student himself, in this part of the subject. A number of qualitative experiments are suggested, several of which could be made roughly quantitative, even without the spherical condenser, charged to a known potential, which Mr. Hansel desires installed in every laboratory.

There is very little fault to be found: too much stress is laid on the experimental verification of the inverse square law with very long magnets; an elementary account of the Cavendish proof of the same law should be given in electrostatics, and an account of the kathode rays and allied phenomena would increase the utility of the book for many students.

Each chapter contains a number of questions, the numerical answers being given at the end. The diagrams, if in some cases rather crude, are clear, and have not been stinted. Anyone seeking a class-book in elementary electricity will scarcely better this.

(2) A complete account of the subject to the standard of the pass degree is given in this, the latest issue from the University Tutorial Press; but the descriptive portions are necessarily reduced to the mere outline required to make the mathematics intelligible. Selected portions will be found helpful by all preparing for examinations in electricity, whether of intermediate or honours standard.

The author's aim is to equip the man already familiar with the elements, so that he may read the advanced treatises with understanding, and at the same time to give him that precision of thought which can only be obtained by working numerical examples. The mathematics involved is of a very simple character, a very slight knowledge of the calculus being required for the chapters on condensers and induced currents.

The last chapter contains a summary of the corpuscular theory, marred by one unfortunate statement. On p. 296 we find: "Practically the whole inertia of the atom is supposed to belong to its negative corpuscles. Of these there are roughly 1800 in the case of a hydrogen atom." Later: "These ideas must not be regarded as facts." True, but they should at least represent the current notions of the subject.

(3) Prof. Houllevigue has collected under this title a set of twelve essays dealing, in a semi-popular fashion, with some modern aspects of

physics and chemistry. In the course of his introduction M. Ed. Bouty pays high tribute to the author's skill as an exponent of popular science, and it must be admitted that the anticipations so raised are not disappointed, for the explanations are clear, the analogies happily chosen, and the whole is written in a bright and interesting fashion.

Among the subjects dealt with are "L'ultramicroscopie" and "Le Mouvement Browien," "L'état colloïdal et la vie," "Le cycle de l'azote," and "Les Terres Rares." This last includes an interesting account of the applications of the so-called rare elements, and justifies to a considerable extent the dictum that "the only really rare bodies are those for which no practical applications are known."

(4) Prof. Goldhammer chooses as the basis of his treatment of dispersion that particular form of the theory first advanced in 1902 by M. Planck. In this book the theory is generalised and extended to conducting media with more than one absorption band. An investigation, in vectorial notation, of the vibration of Planck's resonator—the "Electrische Dipole"—is followed by the development of the theory in terms of this body. The theoretical results are then compared with the experimental data: gases and vapours, solutions, metals and various compounds all being considered. This portion of the book is especially commendable, being fully illustrated with tables of data and curves.

In the last chapter dispersion is considered from the point of view of the electron theory, the author, following J. J. Thomson, making no distinction between the bound and free electrons. It is concluded finally that, so far, this generalisation of Planck's theory is nowhere in antagonism with the results obtained by experiment. An excellent little treatise, being a notable addition to the literature of the subject.

(5) This is the second volume of a complete course of physics based on the notes of lectures delivered at the University of Lille. The work is to be completed in three volumes, of which the first and third are still in the press.

The thermodynamics is treated mathematically on the usual lines, a knowledge of partial differential coefficients being assumed. The ground covered is extensive, and the treatment rather uneven. For example, thermodynamic potential is dismissed in a single page, and the study of the solid state in a chapter of three pages, while, on the other hand, the section on univariant systems is particularly good. Interspersed in the text are a number of worked numerical examples.

Radiation is treated descriptively on modern lines, mathematical formulæ only being given. Nearly a third of this part of the book is devoted to the astrophysical aspects of the subject: an interesting section, but only inserted at the expense of the rest of the subject.

OUR BOOKSHELF.

Les Pyrénées Méditerranéennes, Etude de géographie biologique. By Prof. M. Sorre. Pp. 508+xi plates, 41 figures and a map. (Paris: Armand Colin. 1913.) Price 12 francs.

THIS book is not the outcome of a wholly new method of inquiry, but it is a more complete examination of local influences, past and present, acting in a defined area, than most works of a similar nature. The subject is treated historically, especially in relation to man's activity, from the earliest times, in altering or modifying the aspects and composition of the vegetation and in the development of animal life, in relation to advancing civilisation. It is a consolidation of knowledge obtained by workers in the various branches of research connected with life, animal and vegetable, and physical conditions.

The area under consideration comprises the eastern part of the Pyrenees from Andorra in the west and the whole of the low mountains, hills and plains falling therefrom to the east and to the south, to the sea. There are altitudes of nearly 10,000 feet, and the essentially alpine vegetation begins at about 8000 feet. Phytogeography plays an important part in the history of the human race and naturally occupies a large place in this book, where the results of Prof. Ch. Flahaut's investigations are largely drawn upon. The map shows the distribution of the characteristic trees of the successive zones, beginning with the purely littoral vegetation and followed by the evergreen oak and olive, the stone pine, the cork oak, hairy oak, beech, silver fir, Scotch pine, mountain pine, and the alpine zone.

The plates mostly illustrate *paysages* or scenery, and the figures physical conditions and phenomena. An idea of the arrangement of the matter may be obtained from the headings of the chapters:—I. Les Paysages. II. Le sol et les formes du Relief. III. Climat. IV. Les Eaux. V. Les formes de la Végétation Spontanée; and VI. to VII. Les Genres de Vie of the different regions, with a final chapter on La Vie de relations, son influence sur la Vie locale. W. B. H.

Travers' Golf Book. By Jerome D. Travers. Pp. xi+242+xlvi plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

THIS book will prove interesting reading to all golfers, and especially to those who aim at being champions. Mr. Travers tells how he attained his expertness—simply by thoughtful, deliberate practice. He gives many valuable hints on stance and grip, and elucidates these by means of photographs of himself in all sorts of positions, and

with all kinds of clubs. He has the good sense to abstain from either superficial or profound discussion of the dynamics of the golf ball in air. He has no particular interest in the value of underspin, except in the extreme form for short approaches with mashie or niblick.

The Development of the Human Body. A Manual of Human Embryology. By Prof. J. Playfair McMurrich. Fourth edition. Pp. x+495. (London: Henry Kimpton, 1913.) Price 12*s.* 6*d.* net.

In this edition, Prof. McMurrich, who is professor of anatomy in the University of Toronto, has incorporated the results of all important recent contributions to the subject of human embryology. To avoid increasing the size of the volume unduly, several chapters have been recast and the rest of the volume revised thoroughly.

LETTERS TO THE EDITOR.

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The Post-Embryonic Development of the Spiny Lobster.

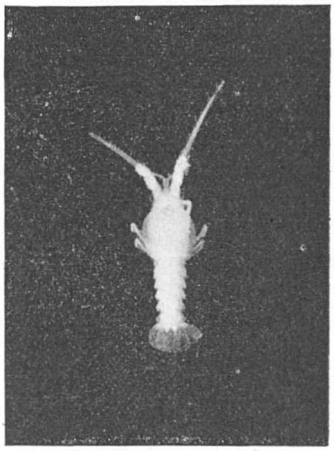
Je reçois actuellement au Laboratoire de Plymouth l'hospitalité scientifique la plus large, comme premier titulaire de la fondation annuelle récemment créée par l'Association britannique de biologie maritime en l'honneur de votre éminent compatriote M. le Professeur E. Ray Lankester. Les recherches que je poursuis en cette qualité me paraissent de nature à intéresser les zoologistes, et comme elles viennent de conduire à un résultat notable, je me permets de vous les signaler en sollicitant pour celui-ci l'hospitalité de votre important journal.

Ces recherches sont relatives au développement post-embryonnaire de la Langouste commune, *spiny lobster* des Anglais, *Palinurus vulgaris* des zoologistes, espèce peu répandue sur les marchés de la Grande-Bretagne, mais fort estimée en France où, d'ailleurs, elle devient rare et atteint des prix élevés. La famille des Langoustes compte à peu près vingt espèces, toutes de grande taille et comestibles, et toutes localisées dans les mers chaudes à l'exception d'un petit nombre qui s'avancent quelque peu dans la zone tempérée. La Langouste commune se range parmi ces dernières; c'est la seule Langouste des mers d'Europe; on la trouve en Méditerranée et, dans l'Atlantique, jusqu'à l'entrée de la Manche où elle atteint Plymouth grâce à la douce température des eaux du Gulf-Stream; on la pêche assez fréquemment autour du phare d'Eddystone.

Le développement post-embryonnaire des Langoustes est des plus remarquables, mais obscur en bien des points encore. On sait, depuis Couch (1857) et Gerbe (1863), que les Langoustes sortent de l'œuf sous la forme de larves pélagiques aplaties et transparentes que Leach (1816) avait prises pour un genre spécial et désignées sous le nom de Phyllosoma; on admet également, depuis les recherches de M. Boas (1881), mises en lumière par M. Calman (1909), qu'elles acquièrent ensuite une apparence macrourienne et deviennent nageuses sous une forme que M. Ortmann considérait comme autonome et désigna sous le nom de Puerulus; mais on n'a jamais suivi, depuis l'œuf jusqu'à l'adulte, le développement d'une espèce de Langoustes, l'on ne sait rien sur le genre de vie des puerulus qui sont d'une rareté extrême (vingt exemplaires environ dans tous les musées du monde), et ce dernier stade, pour notre Langouste commune, est resté jusqu'ici complètement inconnu.

C'est pour jeter quelque lumière sur ces points obscurs que je suis venu au Laboratoire de Plymouth; il se trouve à proximité du phare d'Eddystone, autour duquel notre Langouste commune n'est pas rare et se tient forcément localisée, ce qui le rend, plus que tout autre, favorable aux recherches de cette sorte. Je savais d'ailleurs que M. Cunningham avait recueilli près d'Eddystone, dans la première quinzaine de Juillet, des phyllosomes aux premiers stades, si bien qu'on pouvait s'attendre à capturer au même endroit, un peu plus tard, des phyllosomes plus âgés et peut-être, avec beaucoup de chance, le stade puerulus jusqu'alors inconnu. La réalité, comme on va le voir, a dépassé mon espérance.

Depuis le 20 Juillet jusqu'à ce jour, l'*Oithona*, bateau du Laboratoire, a capturé autour du phare d'Eddystone *tous les stades phyllosomes de la Langouste commune*; il y en a huit pour le moins. Au stade le plus jeune, décrit et figuré par M. Cunningham, la petite larve foliacée mesure environ 3 mm. de longueur; au stade le plus âgé, sa longueur atteint 20 à 21 mm. A l'heure actuelle, la plupart des phyllosomes sont âgés et, sans aucun doute, bien près de leur transformation. Le moment est donc des plus favorables pour obtenir le stade natant ou puerulus.



Puerulus de la Langouste commune; grandeur naturelle (photographie prise par M. F. Martin Duncan, du Laboratoire de Plymouth).

En fait, au cours d'une heureuse pêche effectuée le 31 Juillet sous la direction de M. Clark, on a recueilli des phyllosomes assez nombreux et un magnifique puerulus, *le premier puerulus connu de la Langouste commune*. Il fut pris avec le filet Petersen, entre deux eaux ("mid-water"), dans l'intervalle Looe-Eddystone, au-dessus d'un fond de 27–29 brasses.

Le petit animal est de même longueur que les grands phyllosomes (voir la figure, qui est de grandeur naturelle), comme eux incolore et translucide, mais avec la forme macrourienne normale. Ses grandes antennes ressemblent déjà beaucoup à celles de la Langouste commune, mais les antennes internes sont bien plus courtes et l'arceau qui les porte est bien plus large. Le rostre est réduit à une petite pointe médiane comme dans notre Langouste, mais les cornes rostrales ne présentent pas encore d'armature épineuse sur leur bord inférieur. Le bouclier céphalothoracique a dû se dilater anormalement sous l'action du formol, car ses parois latérales sont toujours abruptes et à angle droit avec la face dorsale dans les autres puerulus; d'ailleurs, il porte déjà quelques-unes des épines propres à l'adulte: deux paires de fortes épines post-rostrales, trois ou quatre paires de spinules gastriques, deux ou trois paires de spinules cardiaques et, sur chaque région branchiale, une série longitudinale de quatre ou cinq autres spinules; on trouve sur les

régions hépatiques, dans le prolongement des grandes antennes, trois fortes épines plus développées encore chez l'adulte, et, à quelque distance en arrière, trois épines branchiales antérieures qui semblent faire défaut à ce dernier. Les grandes pointes marginales des épimères abdominaux ressemblent beaucoup à celles de l'adulte, mais les petites n'existent pas encore, les épines de la nageoire caudale sont moins nombreuses; toutes les autres, si abondantes chez l'adulte, font complètement défaut. D'ailleurs, les téguments sont coriaces et sans calcification aucune, l'abdomen est dépourvu des sillons transverses qu'on observe chez l'adulte, les pléopodes natatoires s'accouplent au moyen de crochets rétinaculaires, et les sternites thoraciques se prolongent en une pointe à la base des pattes, surtout à la base des pattes postérieures.

Ainsi, le petit animal ressemble déjà quelque peu à une Langouste, mais il s'en distingue par de nombreux caractères. On peut être assuré d'ailleurs qu'il passe directement à la forme définitive, car les très jeunes Langoustes sont à peu près de même taille.

On sait que la Langouste commune se range parmi les Palinuridés brévicornes (antennes internes à fouets courts); il en est de même de notre puerulus qui, par là même, ressemble aux puerulus de la Langouste du Cap (*Jasus lalandei*), de la Langouste néo-zélandaise (*Jasus verreauxi*) et d'une espèce caraïbe, le *Palinurus longimanus*. Il se rapproche surtout du puerulus de cette dernière espèce, car il présente comme lui des pointes sternales et, comme lui également, un exopodite flagellé sur les maxillipèdes externes. Les pointes sternales et le fouet des maxillipèdes font totalement défaut dans les autres puerulus brévicornes.

Nous voici donc, pour la première fois, *complètement renseignés sur le développement post-embryonnaire d'une espèce de Langouste*, et précisément sur celui qui nous intéresse le plus, le développement de notre Langouste commune: j'en possède tous les stades, depuis l'œuf jusqu'à l'adulte, et notamment le puerulus resté jusqu'ici inconnu. Que devient ce puerulus? Il est, on le sait maintenant, d'abord pélagique à la manière des phyllosomes, mais il doit gagner très vite le fond où il se cache et où une mue lui fait acquérir la forme des Langoustes.

Les résultats précédents semblent avoir quelque importance, car ils donnent la solution définitive d'un problème qui occupait les zoologistes depuis près d'un siècle. Je dois en rendre grâces au personnel si aimablement dévoué du Laboratoire de Plymouth, surtout au Directeur, M. Allen, qui fit multiplier pour moi les pêches pélagiques, et à M. Clark, Assistant, qui s'est employé à rendre les occupations fructueuses et, aidé de M. Gossen, a recueilli le premier exemplaire de puerulus. J'adresse à tous mes vifs remercîments, —et à vous aussi, Monsieur le Directeur, si, comme je me plais à le croire, vous voulez bien donner l'hospitalité de votre journal anglais à un travail effectué par un Français dans les eaux anglaises.

E. L. BOUVIER,
Professeur au Muséum d'Histoire naturelle de Paris.
The Laboratory, Citadel Hill, Plymouth,
8 Août.

The Origin of Actinium.

THE question of the origin of actinium is one of very great interest at the present time. The law governing the position of the radio-elements in the periodic table led A. S. Russell, K. Fajans, and myself independently to predict the existence of a new member of the uranium series, the direct product of uranium-X, occupying the vacant place in the periodic table in the VA family, the heaviest known representative of which is tantalum. I suggested that if this "eka-tantalum" disintegrated dually, as in the case of the C-members occupying the place in the VB family, one mode with the expulsion of a β and the other with the expulsion of an α ray, the product of the first mode would be uranium-II., and of the second actinium. This could only have remained undetected if eka-tantalum had a very long period. The suggestion was disproved almost at once by the discovery of the missing element by Fajans and Beer, which has since been confirmed by Hahn and Meitner, and also by Fleck in this laboratory. It turns out to be a very short-lived member with a period of average life of about 1·7 minutes, and gives β rays only, the hard β rays before ascribed to uranium-X, which itself gives only soft β rays.

The obvious alternative was that actinium must be produced from radium in a β-ray change, that is that the first change of radium must be dual, the well-known α-ray change into emanation taking place simultaneously with a β-ray change into actinium. This suggestion receives some support from the fact that radium, as found by Hahn and Meitner, does give, in addition to α rays, a very soft β radiation.

But some experiments, of which I now wish to give a preliminary account, seem also to disprove this alternative. A specimen of Giesel's original radium bromide, now ten years old, containing 13·2 mgs. of radium (element) on the international standard, has been examined for actinium, and not the least trace could be detected. During the whole time since it was purchased, it had not previously been removed from its original ebonite capsule or subjected to any treatment. It was found to consist for the most part of insoluble sulphate, due to its action, no doubt, upon the sulphur in the ebonite capsule. It was brought into complete solution as chloride, radium-D, -E, and -F removed with a trace of bismuth by hydrogen sulphide, and a trace of aluminium chloride added and removed with ammonia. The aluminium hydroxide was repeatedly dissolved in acid and reprecipitated with ammonia until free from radium. The actinium and radio-actinium would remain with the aluminium, the actinium-X being completely removed with the radium from which it is non-separable. Tests for the active deposit were carried out in a stream of air, designed to replace the air in the box containing the preparation once every 5·6 seconds, the period of the actinium emanation. This was in order to suppress the effect of any radium relatively to that of the actinium, but it was not necessary, as neither radium nor actinium were present. On the other hand, a minute amount of the pure thorium active deposit was detected.

The α-ray effect obtained in the air stream mentioned with three hours' exposure, four days after preparation, when one-half of the equilibrium amount of thorium-X would be present, equalled that of about 0·15 mg. of uranium oxide, and was amply sufficient to characterise beyond all doubt. At first sight this result is surprising, but it is exactly what is to be expected if the chemical operations had been successful in their purpose. For there is thorium in Joachimsthal pitchblende, withal a very minute amount, and the corresponding mesothorium would be quantitatively removed with the radium, in the course of time to grow radiothorium. The detection of this infinitesimal trace of radiothorium by the active deposit test is a guarantee that if actinium had been formed it would have been detected, for radio-actinium and radiothorium are non-separable. An actinium active deposit, equivalent to less than 0·1 mg. of uranium in activity, could have been detected, and, taking into account the various corrections, it is reasonable to conclude that the full equili-

brium amount cannot certainly be greater than that equivalent in α activity to 2 mg. of uranium. At present the preparation has reached about one-fourth of its equilibrium value as regards actinium-X.

In ten years, of the 13·2 mg. of radium in the preparation, 0·053 mg. would have disintegrated. On the assumption that uranium is the primary parent of actinium, Rutherford has calculated that 8 per cent. of the atoms disintegrating must choose the actinium route ("Radioactive Substances," p. 523). So that, if it were formed from radium, the amount of actinium present in the preparation would be 0·0042 mg. But the active deposit from this quantity has an α activity not greater than 2 mg. of uranium. Hence the period of average life of actinium must be at least fifteen million years, the quantity in minerals must be at least 170 grams per ton of uranium, and the α activity of pure actinium in equilibrium could not be greater than 1650 times that of uranium. But a specimen of actinium, prepared and presented to me by Dr. Giesel, must have, judging from a cursory examination, a far greater activity than this, and Mme. Curie ("Radioactivité," I., p. 189) speaks of some actinium preparations as of the order of 100,000 times as active as uranium. All the researches go to show that its actual quantity in minerals is very small, and, if there were anything like 500 times as much actinium as radium in minerals, one would have expected it long ago to have been isolated and its spectrum and chemical reactions characterised. So that the experiments appear to disprove the possibility that actinium can be formed directly from radium. Similar arguments to those above may be used to show that it cannot be a primary radio-element, and its origin remains still a mystery. In the current number of the *Physikalische Zeitschrift* (p. 752) Hahn and Meitner modify my original suggestion and suppose that the branching of the uranium series takes place at uranium-X, two simultaneous β-ray changes occurring, which produce two eka-tantalums, one the known short-lived β-ray-giving product, and the other a still unknown long-lived α-ray-giving parent of actinium, also in group VA. There seems nothing improbable about this. It is almost the only other alternative remaining to be tested, and it should not be difficult to settle by experiment.

FREDERICK SODDY.

Physical Chemistry Laboratory,
University of Glasgow, August 16.

Radium and the Evolution of the Earth's Crust.

HAVING been away from home, I did not see Mr. Holmes's letter on radium and the evolution of the earth's crust, contained in NATURE of June 19, until some weeks after its publication, and thought that the interest in the subject would have so far passed as to make it not worth while referring to, what I believe to be, a considerable misapprehension of the structure of the earth as revealed by earthquakes. Later correspondence has shown that interest in the subject has not waned, and as a correct appreciation of what has been established regarding the constitution of the interior of the earth seems likely to remove some of the difficulties which have arisen out of the study of radio-activity, it may be useful to review the results obtained from the study of the transmission of earthquake waves to long distances.

To begin with, it must be distinctly understood that this line of research can tell us nothing, directly, regarding the chemical composition of the earth, nor can we distinguish between stony and metallic material; all that can be established is the rate at which two distinct forms of wave motion are transmitted, and if, at any particular depth, we find a marked change in these rates of transmission, we may say that it is caused by a change, either in chemical composition or physical state, of the material through which the waves have travelled. With this premised; the first great change takes place at, probably, about ten miles or so from the surface, and seems to correspond with the passage from the heterogeneous and fractured rocks of the outermost skin to more homogeneous material. Below this, and to a depth of about 100 miles, it is difficult to say whether any further change takes place; there are indications of change at about fifty and about one hundred miles, but it is not such as has a great effect on the rate of transmission of the simpler forms of elastic waves, and, as the differences in the time intervals concerned are not of a greater order of magnitude than the inevitable uncertainties of observation, it is difficult to be certain of the reality of the supposed alteration.

Below a depth of about 100 miles there is no evidence of any change until a depth of about 2400 miles is reached; throughout this layer there is a progressive increase of elasticity, but it is gradual and seems to be directly connected with the increase of pressure, with the result that the material, whatever it may be, develops a high degree not only of resistance to compression but also of rigidity as against stresses of short duration. At the depth mentioned, or at somewhere between 0·6 and 0·5 of the radius, measured from the surface, a very marked and remarkable change in the nature of the material, of which the earth is composed, takes place. The change is rapid, and is characterised by a small decrease in resistance to compression, accompanied by a great reduction, if not the complete disappearance, of rigidity. It is impossible to determine how this change is brought about, but it is very much what would be produced either by passage from the stony shell to the metallic core, of one hypothesis, or from the fluid or solid-fluid to the gaseous state, of another.

Whatever may be the final interpretation of the distant records of great earthquakes, the important point to be noticed is that the two great changes which they indicate in the constitution of the interior of the earth are, first, at a depth of only a few, probably not more than ten, miles, and, secondly, at about 2000 to 2400 miles from the surface. Between these depths there are suggestions of variations in composition down to a depth of 100 miles or thereabouts, but they seem to be of only minor importance, and apart from this no change in physical character, or, presumably, in chemical composition, can be detected.

R. D. OLDHAM.

8 North Street, Horsham, Sussex, August 15.

Poroscopy: the Scrutiny of Sweat-pores for Identification.

AT the recent meeting of the British Medical Association some attention was directed to a method of criminal identification which has been used at Lyons and elsewhere. A fully illustrated account of it occurs in *Les Archives d'Anthropologie criminelle* for July, from which, after careful perusal, I cannot find that there is anything in the method that does not come under the scope and practical working of dactylography. Dr. Locard has shown good reason why we should give more attention than has been usual to small patches of finger-prints, and to seek among the pores for what the ridges are too meagre to supply. Dr. James Scott, at Brighton, rightly describes "poroscopy" as founded on a study of the "impressions or orifices of the sweat ducts of the finger pulp, instead of the ridges." But pores, the openings of sweat ducts, as printed impressions, cannot be studied quite

apart from the ridges, or ridge substance, any more than the holes of which Pat's classic stockings consisted can be considered without reference to the slender remains of the fabric in which they occur.

Dr. Edmond Locard, the writer of the article, "La Poroscopie," alluding to certain landmarks in finger-print patterns (*puntos caracteristicos* they have been called), adduces in one of his illustrations some *îlots* of a single dot, each containing the opening of a single sweat-pore. The effect when printed is that of a more or less regularly shaped O or ring. Of course, if the smoked-glass method were used, what I have called the negative effect would be produced, and the pore would show up as a black dot on a white ground. In such a case as that illustrated the value of such a coincidence would be seen at once, but the value belongs much more to the system of ridges than to that of the pores. A dozen such pores might easily be found to coincide in two patterns having no real relation to each other by way of personality. I should not expect, however, after considerable experience of finger-print patterns, to find three volcanic or coral islets such as are depicted in Fig. 3 coinciding in any but two prints from the same person. But these volcanic islands are not mere pore openings. It is the sharp definition of the ridge element in them that gives character for identification.

It is difficult to conceive of many cases in actual practice where simple coincidence of pores could be made convincing to a jury. Such cases are presented with a magnification of forty-five diameters. But Dr. Locard says:—"Un jury, que trente ou quarante points caractéristiques homologues auront laissé indifférent, sera frappé par la concordance de forme, de position, et de nombre de quelques centaines de pores trouvés identiques sur les deux empreintes comparées." If the illustrations are from the exhibits in the criminal cases quoted, as one would be led to infer, the jury would seem to have been aided very greatly with outlines filled in by official pens, by which the rough places have been made smooth, and coincidences which would not strike any but police officials seeking a conviction, have been made vivid, if not always quite convincing. All this is, I trust, now quite foreign to English criminal procedure.

It is in cases where fewer than some twelve of what an English detective would in the witness-box call "characteristics" are to be found that the additional scrutiny of the pores might be useful. I agree with Dr. Locard that they remain locally fixed in position, but I have mentioned in "Dactylography" (Twentieth Century Science Series), which Dr. Locard does not seem to have read, that, their physiological activity being very variable, their shapes are constantly altering. They may be nearly closed one moment, and quite patent the next, a useful fact which makes it hopeless to forge finger-print signatures effectively with rubber stamps. This variability is most vividly shown in the illustrations to the very article now referred to, and where a finger-print pattern is doubled the pores always agree in position but rarely in shape or size.

HENRY FAULDS.

36 Lichfield Street, Hanley, Stoke-on-Trent, August 13.

Calanus—a Further Record.

ON getting back to Tobermory on Saturday, we found the plankton to be in marked contrast to its condition four weeks ago (see NATURE, p. 504). The vast swarm of Calanids has gone, and there are now no signs of mackerel feeding in the bay. In fact, the change has been noticeable for some days in the seas outside, and we have not been getting lately the large plankton catches that were usual in the latter half of July. On July 14 a haul of the large surface tow-net, in the open sea off Ardnamurchan, gave such a huge catch of Calanus (about 1000 c.c.) that we promptly took a second similar haul, and had it cooked as a sort of potted "shrimp" confection for tea (sampled by ten persons, including the crew, who were much interested to try this new edible "fish"); while on August 11 a haul of the same net, taken at the same spot, gave only a small catch of some 15 c.c., containing very few Calanids, along with the usual scanty summer zoo-plankton. I have not yet seen any statistics of the mackerel fishery, but should not be surprised if this proves to be an exceptionally good year in this neighbourhood, especially in July.

I have only just received NATURE for the last few weeks, and am glad to read Mr. G. E. Bullen's further remarks (p. 531) upon swarms of Calanids and the fisheries. His excellent work—along with that of Dr. Allen—on the connection between mackerel and Calanus and sunshine in the English Channel, some years ago, is valued as the type of observational and statistical work that is required for the investigation of many fishery problems.

W. A. HERDMAN.

S.Y. *Runa*, off Island of Eigg, August 12.

The Structure of X-Radiation.

IN a letter which appeared in NATURE of June 19 we described some effects obtained with various metals used as obstacles to X-radiation, which showed that the bands and haloes produced on X-ray plates up to distances of 450 cm. were neither dependent on crystalline structure (other than metallic) nor should probably be termed "diffraction" effects in the strict sense.

Further investigation, in which crystals have been entirely discarded, has led us to believe that some part of these effects at least must be referred to the structure of the primary beam.

In one of our early trials arranged to study the disposition of the spots from a thin lamina of mica, normal to the beam and covering a quarter of an inch aperture, we were surprised to find that spots were not present, but instead the photo plate, exposed at a distance of 50 cm., was entirely covered by dark parallel bands about half a centimetre in breadth and normal to a sharply defined bright cross. In later experiments without mica, and using cast-iron and other screens, both with and without apertures, a system of crossed similar bands has appeared, and a great number of trials have confirmed the result that particular metals (brass, lead, cast- and wrought-iron, &c., of various thicknesses up to 1 cm.) cannot be held responsible for these phenomena, which have even appeared when no other obstacle than a thick sheet of plate-glass has been interposed. A platinised-nickel antikathode has generally been used and 0·5 to 1 milliampere was kept constant through the bulb.

At it appears from Mr. Keene's letter in NATURE of August 14 he has used only thin sheets of metal *with apertures*, we can understand that he has obtained somewhat dissimilar effects from ours obtained without any aperture in the screen. Also with super-cooled glass plates there can scarcely be any question of crystalline structure. We have substituted special rapid plates of various makers and changed all the non-essential conditions many times. When photo plates are placed one behind the other at distances of 15 cm. (up to 100 cm.) from the source, these bands have invariably shown most clearly on the plates farthest from it. This certainly would seem to suggest masking, by secondary radiation, of an effect which properly belongs to the primary or "hardest" portion of the rays.

W. F. D. CHAMBERS.
I. G. RANKIN.

90 Gordon Road, Ealing.

SCIENTIFIC MOUNTAINEERING IN INDIA.[1] H.R.H. the Duke of the Abruzzi undertook this expedition chiefly in the hope of contributing to the solution of the vexed problem as to the greatest height which can be reached by mountaineers. But, as usual, he supplied himself with such a staff as would be able to make good use of every opportunity which his journey might afford for scientific research. The basin of the Baltoro glacier was chosen for the attempt, owing to the number of high peaks at its head. K^2 itself proved to be unclimbable, in spite of several strenuous attacks and much close reconnoitring, and on July 1 the Duke turned his attention to Bride Peak, 25,110 ft. Such were the unexpected difficulties encountered that it was not until July 10 that camp was pitched on Chogo Lisa Saddle, 20,784 ft. On July 12 a height of 23,458 ft. was attained, but bad weather forced them to retreat. On July 17 another start was made, and that evening they pitched their two diminutive Mummery tents at 22,483 ft., the highest strictly authenticated camp to date, though Rubenson and Monrad-Aas probably camped as high on Kabru.

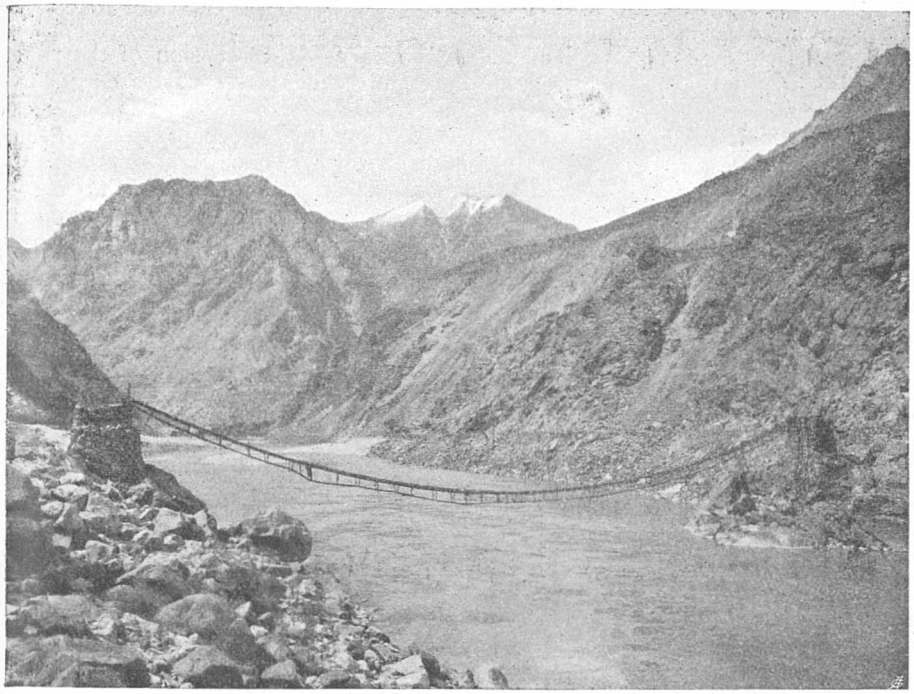


FIG. 1.—Jhula bridge at Karmang. From "Karakoram and Western Himalaya."

Next morning at 5.30 the Duke, with the guides Petigax, Henri and Emil Brocherel, started on what they realised was the final assault. At first all went well. But as they climbed mists settled on the mountain, and the snow got so soft that they sank in 2 ft. or more at every step. Yet "their fatigue was not very great" until at 24,278 ft. they reached a steep outcrop of rock. "Directly they had to climb with hands as well as feet, great difficulty in breathing became apparent," and it cost two hours to reach the highest rocks at 24,600 ft. A steep corniced snow-ridge stretched vaguely up into the mist.

FIG. 2.—Southern view of K^2. From "Karakoram and Western Himalaya."

The recurring tragedies on the Lyskamm are

[1] "Karakoram and Western Himalaya, 1909: An Account of the Expedition of H.R.H. Prince Luigi Amedeo of Savoy." By Filippo de Filippi. With a preface by H.R.H. the Duke of the Abruzzi. Vol. i., pp. xvii+469+plates; vol. ii., plates and maps. (London: Constable and Co., Ltd., 1912.) Price 63s. net.

an eloquent warning to all climbers against persistence in face of such dangers. The Duke waited vainly for two hours in the hope that the mist would lift, but at 3.30 p.m. was forced to retreat. Fortune was against the attainment of the highest peak—and in high mountain and polar regions weather is fortune—but the "man-level" was raised by 700 ft.

It is almost impossible for the uninitiated to realise the courage and fortitude called for by such a feat. For seventeen days they were never below 18,000 ft., and of these nine were spent at or above 21,000 ft. None of the party suffered from mountain sickness, and it is obvious that the limit of man's endurance has not yet been reached. The barometer stood at 12·35 in.: a further drop of only about 1·6 in. would be registered on the top of Mount Everest. But the successful aspirants will be very exceptional individuals—and of a consummate resolution

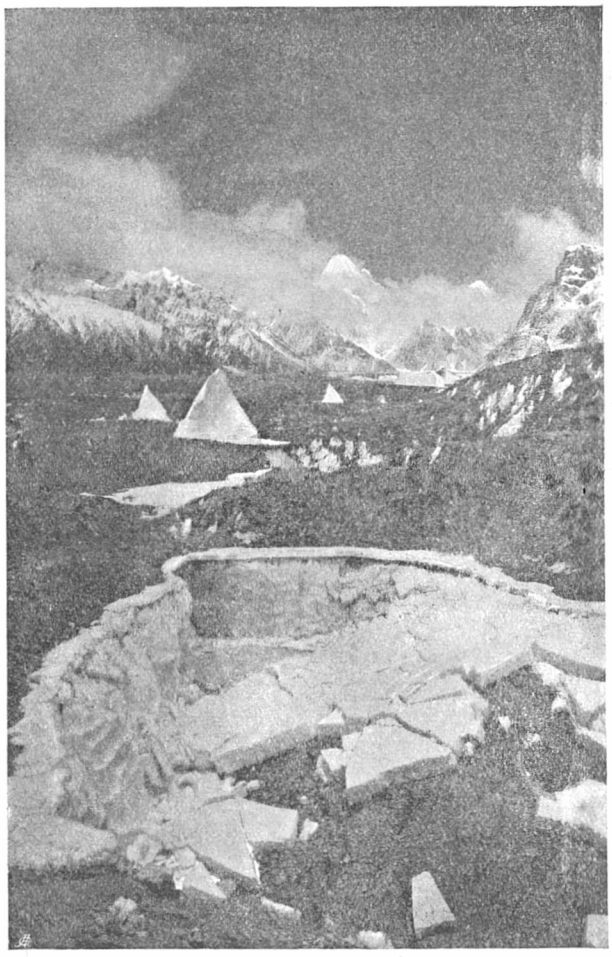


FIG. 3.—Empty basin of glacial lake. From "Karakoram and Western Himalaya."

Dr. de Filippi has produced much more than an interesting and readable account of a memorable mountaineering expedition. Almost every chapter gives him occasion for the discussion of some branch of physical science. He appears to be familiar with the whole of the literature of his region, and gives so many references to the writings of his predecessors and other authorities that his book has the further merit of being, in the best sense, a work of reference.

The author's suggestive discussion of the past history of the Indus valley is of particular interest, but cannot be dealt with in this brief notice. Naturally glacial phenomena occupy most of his attention, and he throws new light on several vexed questions. The puzzling fact that the greatest glaciers of this region lack terminal moraines is ascribed to the immobility of their lower reaches. In a very long glacier lying in a narrow trough any increment shows itself by a rapid advance of the snout. The glacier overshoots itself, and if the increment is only temporary and the excess of pressure abates, this overshot portion becomes, in effect, merely a mass of stagnant, dead ice. Rickmers has reached, quite independently, a similar conclusion in regard to some of the glaciers of Russian Turkestan. Probably the few large boulders which do reach the snout of these great glaciers quickly sink below the surface of the water-soaked plain of glacial débris which is such a typical feature at the snouts of most of these glaciers.

The fact that the most careful barometric readings consistently gave lower values than trigonometrical observations suggests a reference to variations in gravity. It is by research on the lines adopted by Burrard that we may eventually look for an answer, and this problem is one of the many which the author has placed on the programme of his expedition to Baltistan and Ladak for 1913–14.

The author agrees with Ujfalvy in ascribing to the Baltis an Aryan rather than a Mongol ancestry. It is pleasant to read of the excellent relations existing between the Italians and their Balti coolies, for whom the author has nothing but praise and admiration, and to whom he frankly acknowledges much of the success of the expedition was due. The geological results are specially dealt with in an appendix. The most striking discovery was that the main axis of the Gasherbrum range consisted of sedimentary rocks, notably conglomerates and marbles. These are continued into the Teram Kangri range north of the Siachen glacier, and quite probably still further to the eastward.

The narrative is enriched with numerous illustrations by Vittorio Sella, that prince of mountain photographers; it is impossible to praise them too highly. In a separate case, uniform with the narrative volume, are placed a very remarkable series of large panoramas. These with the maps combine with the letterpress to give an extraordinarily vivid description of the region dealt with, especially of the Baltoro glacier. A useful innovation is that the indices are placed in a loose fascicle along with the panoramas and maps, which obviates the difficulty of reference so distracting with a heavy volume.

A CRITICISM OF MODERN METHODS OF MEDICAL EDUCATION.[1]

THE report drawn up by Mr. Flexner for the Carnegie Foundation is a sequel to the report on medical education in the United States and Canada issued in 1910. Primarily intended for the guidance of medical education in the United States, the report deals so fully with conditions in Germany, Austria, France, England, and Scotland, and adopts so critical an attitude towards them, that it must compel the attention not only of those directly concerned, but of educational authorities everywhere.

The report opens with an historical sketch of the rise of modern medicine, and is followed by a chapter on the number and distribution of physicians in the countries under review. We learn that the medical profession is overcrowded both in countries like Austria and Germany, where the practitioner is educated entirely on a high university basis, and in countries like our own, where medical qualifications of varying standards, some undeniably low, are obtained partly in universities and partly in proprietary schools under the control of the medical and surgical corporations. A later chapter in the report shows how quackery flourishes in Great Britain and Germany, a phenomenon Mr. Flexner attributes solely to the laws which permit it. Incidentally he remarks upon the inconsistency of British law which throws all manner of restrictions upon properly qualified men of science in experimentation upon the lower animals, but allows medical and surgical practice upon human beings without evidence as to training, competency, or skill, provided only the practitioner does not assume an unearned title.

From a purely educational point of view the most interesting part of the report is that which deals with the nature and standard of the medical preliminary examinations, and with the position of the preliminary sciences, physics, chemistry, and biology. The conditions in Germany, France, and Great Britain are closely reviewed, and much valuable information is collected. The German system of secondary-school leaving certificates, and the somewhat similar French system, are favourably considered; the want of method, multiplicity, and low standard of some of the British medical preliminaries receive severe condemnation. The work of the General Medical Council in raising the standard of the preliminary is acknowledged, but the condition of secondary-school education in England, though improving, is still lamentably poor, proprietary interests in the medical schools, and even in the universities, constitute a formidable barrier to progress, and the General Medical Council is not vested with sufficient legal authority to enforce everything it deems desirable.

The existence in Great Britain of proprietary interests in the teaching of medicine meets with severe criticism throughout the report; again and again vested interests are held responsible for inefficient teaching, low standards, and other evil influences. While we can agree with the author in many of his strictures, it must be remembered that the proprietary conditions have often been the only ones possible in a country which prides itself upon the voluntary character of its institutions. It must be remembered, too, that this report is drawn up for an educational body in the United States, where the proprietary medical school is a source of much scandal. The president of the foundation, in an introduction to the report, states that if the lowest terms upon which a medical school can exist abroad were applied to America, three-fourths of the existing American schools would be closed at once.

Mr. Flexner advocates the omission of physics, chemistry, and biology from the overcrowded medical curriculum, and would have them taught in the secondary schools. Much of this part of the report is a plea for the development of efficient secondary schools in which higher mathematics, the sciences, and German must replace the time-honoured classics.

Laboratory development is found to be very uneven in Great Britain as compared with Germany. Anatomy is too much drilled into the students by repeated lectures and demonstrations; more practical work is necessary, but is largely restricted by insufficiency of material. British physiology receives a high tribute, but is hampered by the student's lack of preliminary training in physics and chemistry, and by the anti-vivisection laws. Pharmacology barely exists but for a few notable exceptions. Pathology suffers by the separation of its laboratories from the post-mortem departments of the hospitals, by lack of funds for research, and by sentimental objections to pathological experimentation which carry great weight in hospitals chiefly supported by voluntary contributions.

Clinical instruction, the medical curriculum, and the position and standard of the professional examinations are each considered separately in the case of Germany, Great Britain, and France. Clinical education in England is essentially practical, and at graduation the English product is more dexterous than the German, but the latter is held to have received the more stimulating scientific training, and one which will eventually carry him further. The English graduate lacks ideas, the German lacks practice.

Criticism is abundant and frankly bestowed. The clinical school in Great Britain is accused of being unproductive of research, and wanting in scientific ideals. The German clinician and the British physiologist seek advancement by scientific achievement. The English medical man is able and practical, makes a good physician and surgeon, but is empiric, and only occasionally a contributor to scientific knowledge.

The report is bound to excite adverse criticism, for it is often detailed and very frank. It is the

[1] "Medical Education in Europe." A Report to the Carnegie Foundation for the Advancement of Teaching. By Abraham Flexner. With an Introduction by Henry S. Pritchett. Pp. xx+357. (New York City: 576 Fifth Avenue, 1912.)

work of an educational expert who has certain ideals, and does not hesitate to show how far existing conditions differ from them. Strong opinions are given on the vexed question of the London hospital medical schools, and on the constitution of London University. How far the recommendations are practical is a question that must be left for the authorities concerned to decide. It is certainly desirable that London as a teaching centre of medicine should not occupy a position inferior to the great schools of Berlin, Vienna, and Paris.

Whatever we may think of some of the author's criticisms, one cannot but admire the ability and thoroughness with which he has collected information and drawn up his report. Educationists generally, and medical teaching authorities in particular, owe a debt of gratitude to the Carnegie Foundation for the Advancement of Teaching.

LIQUID CRYSTALS AND THE X-RAY WORK.

IN two memoirs contributed to the current volume of the *Verhandlungen des Naturwissenschaftlichen Vereins,* Karlsruhe, Prof. O. Lehmann gives a valuable summary of his well-known researches on the so-called liquid crystals, and reviews the proofs now available of molecular structure and of the operation of molecular forces, and especially the tangible proofs of the actual existence of molecules. Naturally, the most interesting part of such a communication from Prof. Lehmann is the expression of his views concerning the most recent of such proofs, afforded by the experimental work of Laue, Friedrich, and Knipping with X-rays and crystals at Munich and Zurich. The events leading up to this remarkable development are clearly indicated, and their individual significance emphasised. From the initial stages of the kinetic theory of gases in the days of Count Rumford and Robert Mayer—the former of whom was connected with Munich, and is there represented by a fine statue—to the reflection of X-ray electromagnetic waves from the invisible parallel planes of atoms in the interior of a crystal, and the impression of the systematic symmetry of the crystal on a photographic plate by the reflected rays, is a long step.

It will be with universal consent that Prof. Lehmann hails this new work as of richest consequence not only to crystallography, but to general physics. He considers it the first practical proof of the existence of those molecular forces which he has so long contended for as causing the deposition, layer upon layer in regular order, of the chemical molecules in their erection of the edifice of a crystal—that is, in the production of a three-dimensional grating or "space-lattice."

One of the surest signs of the magnitude of the discovery made at Munich is the fact that the experiments, as on the occasion of the discovery of radium, are being repeated and extended by numerous workers all over the world, as the columns of NATURE, in which many of the results have been described, have lately abundantly testified.

It is a generally accepted maxim amongst men of science that the pioneer of a new discovery should be permitted to work out undisturbedly its further development, and it is sincerely to be hoped that Prof. Laue and Drs. Friedrich and Knipping will be able to carry their work to its logical conclusion. The bearing of the discovery on Prof. Bragg's theory of X-rays has, however, fully justified its further independent investigation by him and by his son, Mr. W. L. Bragg, who has crystallographic knowledge, and has added very considerably to the subject, both by further experiments and by an explanation which agrees with the crystallographic facts in a most remarkable manner. There are indications that the near future will see a surprising further development in the direction of arriving at the absolute dimensions of the cells of the space-lattice—that is, of the actual distances separating the chemical atoms, thus converting the topic axial ratios, which have been so useful a conception for affording us the relative dimensions of the cells in related compounds, into absolute spacial values. Moreover, the dimensions of the material parts of the atoms themselves appear likely to be also determinable within definite narrow limits, for the reflector, the atom, must be larger than the wave reflected, and it is now clearly proved that an ordinary reflection, and not a diffraction effect, is in question.

Another secondary result is that the intensity of the reflection is proving a direct function of the density with which the atoms are strewn in the reflecting plane, thus affording us an experimental means of carrying out Prof. von Fedorow's quest for the primary facial planes, so as to arrive at a proper descriptive setting for the crystal; for these primary planes, sometimes obscured by fortuitous better development of other planes on the exterior of the crystal, are invariably those most densely strewn with the atomic points.

For a discussion of the physics of the whole subject, especially as regards the position immediately before the Munich discovery, the two memoirs of Prof. Lehmann forming the subject of this notice may with advantage be consulted. A brief abstract of some of the most recent work of Mr. W. L. Bragg will be found in the report of the proceedings of the Mineralogical Society of June 17 (see NATURE of June 26, p. 441).

A. E. H. TUTTON.

THE PILTDOWN SKULL.

AMONG the questions discussed by the anatomical section of the International Congress of Medicine was the date and reconstruction of the famous Piltdown skull. At South Kensington the fossil portions of the skull have been put together by Dr. Smith Woodward so as to represent a being partly ape, partly human, and named *Eoanthropus dawsonii.* From this model the brain gives a capacity of 1076 c.c.—an amount

intermediate between the highest anthropoid and the highest form of man.

Dr. Smith Woodward fixes its date in the very early Pleistocene period, contemporary with the well-known Heidelberg jaw. Prof. Rutot, of Brussels, assigns the Piltdown stratum of gravel in which the remains were found to the latter part of the Pliocene period. If these views be accepted, it is of much earlier date than the remains of Neanderthal man recently discovered in France; and while Prof. Rutot estimates the duration of the Pleistocene period at 150,000 years, Prof. Penck, one of our greatest authorities on the Glacial period, estimates its duration from half a million to a million and a half of years.

On the other hand, Prof. Keith, of the Royal College of Surgeons, has articulated the portion of the skull to represent a large and well-modelled human head with a brain capacity of 1500 c.c—an amount slightly above the average of modern human brains.

The difficulty of accepting Dr. Smith Woodward's reconstruction is in believing that Eoanthropus could be transformed into modern man in the short period represented by the first half of the Pleistocene period. On the other hand, to quote the admirable summary of the question in *The Times* of August 11, "if Prof. Keith is right, then it is quite possible that mankind may have reached the stage represented by the Galley Hill remains before the middle of the Pleistocene period. If Dr. Smith Woodward is right, we have to seek the beginnings of our modern culture and civilisation at the middle of the Pleistocene period; if his opponent's reconstruction is well founded, we have to go a whole geological period further back—perhaps a million of years—to find the dawn of modern man and his culture."

In the discussion which took place, reported in *The Times* of August 12, the weight of scientific opinion seems to have been decidedly in favour of the views of Prof. Keith. But the importance of the question is so vital to the science of anthropology that we may be well advised to await further developments of the controversy.

HELMINTHS AND CANCER.

IN a memoir recently published,[1] Dr. Johannes Fibiger brings forward strong evidence in support of the view, by no means novel, that the lesions of the tissues produced by parasitic worms may act as the starting-point for the development of cancerous growths and tumours. The author found in wild rats a disease of the œsophagus and stomach characterised by an epithelial proliferation and inflammation leading, in pronounced cases, to a papillomatous growth which was the precursor of a malignant epithelioma. Examination of the primary lesions revealed the presence of a nematode worm, an undescribed species of Spiroptera.

From a series of experiments it was concluded that cockroaches (*Periplaneta americana* and *P. orientalis*) serve as intermediate hosts for the Spiroptera. The cockroach becomes infected by ingesting eggs of the worm which are passed out in the excrement of the rat; the eggs develop in the cockroach and the embryos of the worm become localised in the striated muscles of the prothorax and the legs. The rats become infected by eating cockroaches, and the embryos of the worm, set free from their cysts, attack the epithelium of the stomach, sometimes also that of the œsophagus or buccal cavity, and develop into the adult nematode, the cause of the lesions already mentioned. From his investigations the author concludes that all the anatomical alterations are due to toxic products of the nematode.

From the primary lesions caused by the nematode secondary metastases may be produced in other organs. The metastases contain neither the parasites nor their eggs. The development of the metastases is ascribed to the faculty of the epithelial cells to multiply in other organs independently of the parasite. The author thus confirms the view put forward by Borrel and others that nematodes may produce malignant tumours in rats and mice, and considers it not improbable that in human pathology also cancerous tumours may owe their origin in some cases to the presence of helminths.

[1] Oversigt Kgl. Danske Videnskabernes Selskabs Forhandlinger, 1913, No. 1.

NOTES.

A CIRCULAR from the Institut International de Physique Solvay informs us that a sum of 20,000 francs is available for the encouragement of experimental work in physics and physical chemistry, particularly for investigations on radiation phenomena (Röntgen rays and those of radio-active bodies) and for studies of the theory of energy quanta and of molecular theories. Grants from the fund will be awarded, without distinction of nationality, by the administrative commission of the institute on the recommendation of the international scientific committee. The administrative commission is composed of Profs. P. Heger, E. Tassel, and J. E. Verschaffelt, Brussels, and the scientific committee of M. H. A. Lorentz, president, Haarlem; Mme. M. Curie, Paris; M. Brillouin, Paris; R. B. Goldschmidt, Brussels; H. Kamerlingh-Onnes, Leyden; W. Nernst, Berlin; E. Rutherford, Manchester; E. Warburg, Berlin; and M. Knudsen, secretary, Copenhagen. Applications for grants should be made before September 15 to Prof. H. A. Lorentz, Zijlweg 76, Haarlem, Holland. They should state precisely what problems are to be investigated, the proposed means of inquiry, and the amount required, in order that the committee may have before it all details necessary in considering the awards to be made.

AN exhibit illustrating the damage caused to biscuits sent out in soldered tins for the use of the troops in South Africa—especially during the Boer war—Gibraltar, Malta, Ceylon, &c., has just been placed in the central hall of the British Museum (Natural History), where it will be kept open about a month. The larvæ of certain minute moths and beetles were the active agents; and it appears that since these

cannot, in all probability, withstand the high temperature to which the biscuits are subjected in baking, the eggs must be laid by the moths during the period when the biscuits are being cooled before tinning. Two species of moths, *Ephestia kuehniella* and *Corcyra cephalonica,* both imported into this country, are the chief causes of the damage; and as a consequence of the ravages of the larvæ, the contents of many of the tins are reduced to uneatable rubbish.

THE death is announced, as the result of an accident, of Prof. C. Bourlet, professor of mechanics at the Conservatoire des Arts et Métiers in Paris.

THE Permanent International Eugenics Committee has accepted the invitation of Dr. C. B. Davenport, of Cold Spring Harbour, Long Island, to hold the International Eugenics Congress in the United States next year, probably in the month of September.

MR. C. CARUS-WILSON has recently presented to the Royal Albert Memorial, Exeter, the large specimen of a granite geode exhibited by him at more than one Royal Society soirée, and awarded the bronze medal of the Franco-British Exhibition. The specimen is a fine mass of granite in which the mineral constituents have crystallised out around the walls of a large cavity.

IT speaks well for a general appreciation of the scientific value attaching to Arctic and Antarctic research that the actual conquest of both poles has not been followed by any diminution of exploring activity. News is to hand of the success of Captain Koch's Danish expedition for the crossing of Greenland. Captain Koch, who accompanied Mylius Erichsen on the journey which ended with that brilliant explorer's death, started in June, 1912, with the object of visiting Queen Louise Land. The party failed to carry this out owing to an accident which kept Captain Koch a prisoner for three months, after which winter was passed on the inland ice of Greenland. The expedition, starting on April 20 of this year from near the east coast, reached Proeven, near Upernivik, in the middle of July, after a march of 750 miles towards the close of which the party was within a few hours of starvation. A more prolonged journey is planned by Captain Amundsen, the first explorer to reach the south pole, who is shortly to board the *Fram* at Colon, when that famous vessel will sustain the honour of the first passage through the Panama Canal. She will then convey Amundsen to the Arctic, where he hopes to carry out a drift (such as Nansen attempted) across the polar area, being prepared to spend six years over the task, a period which should afford him almost unprecedented opportunity for scientific investigations.

IN the issue of *Man* for August Mr. T. A. Joyce describes the representation of the clan ancestor in animal form on ancient pottery from the Peruvian coast. The result of the investigation is to emphasise the importance of the clan ancestor in Peruvian cults, to illustrate the custom of dancing in dresses simulating animals, these dresses being almost the only kind of personal property under the communistic system of the Incas, and to show the wide distribution of the centipede as a *huaca* or totem in the Nasca Valley.

PERHAPS the most important paper in the excellent issue of the Journal of the Royal Anthropological Institute for January–June is the report by Mr. A. R. Brown, Wilkin student in ethnology, Cambridge, on three tribes in Western Australia—the Kariera, Ngaluma, and Mardudhunera. The paper describes in detail the complicated tribal organisation, totemism, rites of initiation, sociology, and religious beliefs of a people now rapidly disappearing. A good series of outline maps and a bibliography of the scanty published literature add to the value of this paper.

IN the issue of *L'Anthropologie* for January-February, 1913, Prof. H. Breuil and H. Obermaier publish a review of the work done in examining the cave paintings in Spain during 1912. A number of curious illustrations of men and animals is provided. The visit of M. Breuil and Prof. Sollas to Bacon Hole, near Swansea, is described. It is possible that the red bands observed on the cave walls may be the work of Palæolithic man, or they may belong to some later period; but there is no reason for trusting the local gossip which ascribes them to quite modern times.

IN 1906 Mr. R. F. Cummings supplied the Field Museum at Chicago with funds for an ethnological expedition to the Philippine Islands. The first part of the results of the investigations by Mr. F. C. Cole has now been issued in vol. i., No. 1, of the Museum's Anthropological Series. It is devoted to a study, historical and ethnographical, of the introduction of Chinese pottery into the islands. This pottery was chiefly intended for use by some of the Filipinos as burial jars. These in time acquired a high value, and were believed to possess supernatural properties. Among some tribes the bride-price is paid wholly or partly in jars. Porcelain plates are used by female mediums in summoning spirits, and such plates are so highly valued that they are never sold during the lifetime of the medium, and after her death only to her successors in office. The medium falls into an ecstatical state, chants songs invoking the spirits, and holding the plate on the finger-tips of her left hand, she strikes it with a string of seashells or a piece of lead, in order that the bell-like sound may attract the attention of the spirits. Suddenly a spirit possesses her, and she announces its wishes to the audience. This elaborate and well-illustrated monograph will interest anthropologists and collectors of Oriental porcelain.

A PROFUSELY illustrated article by Mr. George Shiras on automatic flashlight photography of wild animals by night forms the leading feature of the July number of *The National Geographic Magazine.* In fixing self-acting cameras in the haunts of nocturnal mammals, the author states that he has frequently used the same baits and scents as those employed by the trapper, and he adds that in many instances animals, after a brief experience, take little or no notice of the flashlight, which they perhaps regard as a form of lightning.

MR. M. C. TANQUARY has published, as article 9 of vol. ix. of the Bulletin of the Illinois State Laboratory

of Natural history, an account of recent biological and embryological studies on Formicidæ, based on investigations into the habits and life-history of the American cornfield ant (*Lasius niger americanus*). Although this is believed to be the most abundant insect in the United States, such an investigation had never previously been undertaken, so that a number of new facts in its ecology have been brought to light.

ALTHOUGH the majority of the birds represented by fossil bones in the Pleistocene of the Oregon desert belong to species still existing, it is not a little remarkable that they include two extinct species of swan, one of which—*Olor matthewi*—is described for the first time in a paper on the fauna of the tract by Dr. R. W. Shufeldt, in the Bulletin of the American Museum of Natural History, vol. xxxii., art. vi. Noteworthy, too, as indicative of climatic changes, is the occurrence of remains of the snow-goose. In connection with the determination of fossil bird-bones, Dr. Shufeldt points out that in many cases allowance must be made for great differences in length due to differences in age and sex of the birds to which they belonged, and other conditions. Neglect of this may lead to very erroneous determinations.

AT the conclusion of an article on the food of insects in *Naturwissenschaftliche Wochenschrift* of July 13 and 20, Dr. Hans Petersen points out that the chlorophyll found in the intestine of caterpillars becomes modified into a red substance—"vanessa red"—which is used in the epithelium, and, after pupation, as a pigment in the wings and other parts. Part of the red matter remaining unabsorbed in the intestine is finally voided. He also comments on the remarkable fact that the larvæ of clothes-moths subsist on absolutely dry keratin—the main constituent of wool—which all other animals seem completely unable to digest and assimilate. In regard to the consumption of wax by the larvæ of the wax-moth, it is considered that although this substance is essential to their existence, it is largely supplemented by remnants of pollen, honey, &c.

APPARENTLY more or less harmless in its reputed native country, the Argentine ant (*Iridomyrmex humilis*) is a serious enemy to vegetation and crops in the numerous lands—including the warmer parts of the United States, Madeira, and Portugal—into which it has been introduced. So injurious indeed is this insect in Louisiana and some of the neighbouring States that its ravages, according to a special report by Messrs. W. Newell and T. C. Barber, published as Bulletin No. 122 of the U.S. Bureau of Entomology, are fully as bad as those of the caterpillars of the gipsy-moth, the boll-weevil, and the San José scale-insect. With the view of checking this mischievous ant, full details of its life-history have been worked out and recorded in the bulletin, together with suggestions as to remedial measures. In the orange orchards, where these ants have done incredible damage, the most successful plan has been to induce the colonies to congregate during winter in boxes filled with decaying vegetable matter, where they are subsequently destroyed by means of carbon bisulphide.

DR. P. VAN HARREVELD, who some years ago (*Rec. d. Trav. bot. Néerlandais*, vol. iii.) pointed out various imperfections in the forms of klinostat hitherto used in experiments on geotropism, heliotropism, and other phenomena of movement in plants, has now published in the same journal (vol. ix.) an account of a new form of this instrument devised by him. This "Universal Klinostat" is of somewhat complicated construction, which is illustrated by eighteen figures showing the various parts in detail, and the author claims that his form of this important instrument successfully eliminates all the sources of error arising from the use of the forms of klinostat that have been in use up to the present time; for details reference must be made to the author's paper.

WE have received a copy of Prof. Guignard's memorial notice on the life and scientific work of the late Dr. Edouard Bornet, who died on December 18, 1911, at the age of seventy-three years. The list of Bornet's publications extends to nearly sixty titles, but he will be best remembered for his work on the algæ, and particularly for the two well-known volumes "Etudes phycologiques" and "Notes algologiques," which he produced in collaboration with Thuret between 1876 and 1880. The magnificent plates which illustrate these two works have never been surpassed for beauty and fidelity to nature in the entire range of botanical literature. In Prof. Guignard's admirably written and sympathetic sketch of Bornet's labours, we are taken back to what now appear extremely remote times and shown what an important part Bornet played as a pioneer in establishing the sexuality of the cryptogams and the dual nature of the lichens.

IN a paper of considerable interest to geologists as well as to botanists, Dr. J. B. Scholz (*Engler's Bot. Jahrb.*, vol. xlvi.) discusses the "steppe problem" of the north German plain. There is at the present day a strong contrast between the mild equable climate of north-west Europe and the dry continental climate of the steppes of south Russia and west Siberia, but that the steppes had formerly a greater westward extension during at least one drier climatic phase in late Glacial times was shown by Nehring from the distribution of the loess with its characteristic steppe fauna, implying a corresponding steppe flora and climate. Scholz now brings forward various botanical evidences against the probability of a long steppe period in west Prussia, with interesting notes on the distribution of the characteristic steppe grass, *Stipa pennata*, and accompanying plants, pointing to the conclusion that these plants have entered north Germany along the valleys of the Vistula, Oder, and Elbe, all of which have the general direction south-east to north-west.

IN a paper published by the Survey Department of the Egyptian Ministry of Finance, Dr. John Ball discusses the occurrence of the phosphate deposits found in the localities bordering on the Red Sea coast and in the Nile districts. In the Safâga district alone

these phosphate beds are believed to exist over about fourteen square kilometres, and have been found to contain 20 to 70 per cent. of tricalcic phosphate. During the five years 1908–12 the output of phosphate has risen from 700 to 70,000 tons, and, now that the mines are connected by rail with the seaboard, Egypt bids fair to contribute a not insignificant portion of the world's production.

THE first part of vol. viii. of the quarterly *Agricultural Journal of India* contains a number of interesting and important papers, including the following. Mr. H. Maxwell-Lefroy reports at length upon the Psylla disease of indigo, which apparently causes part only of the unhealthy conditions observed in the plants. The author considers that the insect is the direct cause only of curling of the shoot tips and leaves, with a checking of growth, leading to decreased weight of cut plant and a small decrease in the seed yield; while the more extensive and serious disease symptoms exhibited by indigo plants are attributed to some at present unknown organism or physiological cause quite independent of Psylla. The issue includes papers on the improvement of Indian wheat, by Albert and Gabrielle Howard, and that of the indigenous cottons of the United Provinces, by H. Martin Leake and A. E. Parr; while G. S. Henderson contributes an interesting paper on dry farming, based on his visit to dry-farm stations in Texas and New Mexico, and C. M. Hutchinson describes experiments on the relation between drainage and the growth of rice.

IN a paper by Prof. A. J. Ewart and Mr. Norman Thomson, published in the Proceedings of the Royal Society of Victoria (vol. xxv., p. 193), the question of the possibility of cross-inoculation of the root-tubercle bacteria upon native and cultivated leguminosæ is discussed. It was found impossible to cause the growth of root nodules on a number of commoner leguminosæ by inoculation with infusions of the tubercles of certain native legumes, such as *Acacia mollissima*, and different species of Papilionaceæ. This is apparently due to the fact that the bacteria of such nodules are incapable of directly adapting themselves to a new host plant. On the other hand, when the bacteria from one plant are grown on nutrient gelatin media, they appear to develop more generalised infective power, and it was found possible readily to infect peas and broad beans, grown both in water cultures and in sterilised soils, with bacteria from acacia nodules, isolated and cultivated on nutrient gelatin. Root-tubercle bacteria taken directly from the living tubercle are, however, apt to die out in sterilised soil or in water cultures before they have become sufficiently generalised to be capable of infecting a foreign host plant.

THE earthquake of November 8, 1912, in the south-east of Luzon presented several features of interest (Bulletin of the U.S. Weather Bureau). It was preceded by a number of slight shocks, beginning on November 5. Though strong enough to cause considerable damage, the meizoseismal area was small, being only twenty-two miles long and six miles wide. As the Rev. M. Saderra Masó points out, this implies that the focus was close to the surface. The earthquake was nevertheless registered at Hamburg and San Fernando, more than 6000 miles from the Philippine Islands. No lives were lost, owing to the lowness of the houses, the lightness of their materials, and the ample time that elapsed before destructive intensity was attained.

PROF. OMORI has recently described the extraordinary volcanic eruption of the Usu-san in July and August, 1910 (Bull. Imp. Earthq. Investigation Com., vol. v., 1911, pp. 1–38). The eruption was accompanied and followed by the formation of a new mountain on the northern flank of the volcano. By November the height of this mountain had increased by 510 ft., though by April, 1911, this amount was lessened by 120 ft. In a later paper in the same volume of the bulletin (pp. 101–7), Prof. Omori shows that the elevation-phenomena were not confined to the northern side. At his request the heights of the first order bench marks were re-determined to the west and north-west of the volcano in the summer of 1911, and along the same lines and also on the south side of the mountain in the summer of 1912. The first measurements indicated an elevation of the ground surrounding the mountain to a distance of three to five kilometres to the west, the maximum rise being about $2\frac{1}{2}$ metres. At a greater distance to the west there was a slight subsidence. The measurements made in 1912 showed a reversal of the movement, the area surrounding the mountain being slightly lowered, while that beyond to the west was slightly raised.

THE meteorological charts of the North Atlantic for August, issued by the Meteorological Office and the Deutsche Seewarte, contain interesting details relating to the ice in that ocean. On the east and north coast of Newfoundland, and on the northern half of Newfoundland Bank and eastwards, many icebergs are still met with. The latest reports received from the scout-ship *Scotia* relate to ice between 48° N. 50° W., and 47° N. 45° W., July 11 to 15. During June icebergs were met with, east of 45° W., as far south as the steamship routes. Small charts are published by the Meteorological Office giving the extreme limits of icebergs in the north-western Atlantic for each of the months March to June during twelve years ended 1912, and also during the year 1913. This year the bergs have been confined to higher latitudes, as a general rule, than in previous years. This is thought to be probably due to a northerly extension of the Gulf Stream, a northerly set having been reported by several steamers. The bergs seen have been comparatively few in number and of small dimensions.

THE *Mitteilungen aus den deutschen Schutzgebieten*, vol. xxvi., part 1, contain valuable tables of monthly and yearly means of meteorological observations for 1911, made under the auspices of the Imperial Colonial Office, and discussed at the Deutsche Seewarte under the able superintendence of Dr. P. Heidke. Among several useful articles we may mention an

investigation of the nature of the obscurity of the air during the prevalence of the Harmattan wind at Togo, West Africa, with reports (1) by Captain v. Seefried, who conducted the experiments with glass filtering tubes packed with wadding, and (2) by the Geological Central Section for German Protectorates. The cloudiness has been supposed by some authorities to be due to ashes from grass fires, and by others to dust particles from desert regions. The geological report is to the effect that the principal cause is essentially due to the remains of diatoms, and that the presence of particles of ashes is only to be considered as a secondary and local phenomenon. It is pointed out that this result agrees with opinions as to the nature of the dust observed in the vicinity of Cape Verde Islands, and it is suggested that some botanist skilled in the examination of diatoms might determine from their forms the place of origin of the dust particles obtained in Togo.

THE Survey Department of Egypt has recently published an important volume containing daily readings (August, 1872–December, 1911) of the Nile gauge at Roda (Cairo), together with summaries and diagrams. In a preface by Mr. J. I. Craig (director, Meteorological Service) it is pointed out that projects are in hand, or proposed, that will tax the supplies of the river to the utmost, and that it is more than ever desirable that existing records should be made accessible. With the exception of the nilometer at Aswan, the gauge at Roda is the oldest in the country; its readings have been recorded (with several gaps) for about thirteen centuries, but it is only from 1872 that complete daily readings exist, and up to the end of 1899 these were recorded according to the Coptic calendar and in old measures, so that the figures were of little value to European investigators. The formidable work of conversion to Gregorian dates and to modern measures, together with computations for the whole period in question, has been carried out with scrupulous care by Mohammad Effendi Kâsim (inspector, Meteorological Service), who has also contributed the introductory text. This period of daily records includes five cases of high floods (exceeding 20 metres) and five cases of low floods (not exceeding 18 metres), also years of abnormally early and late floods, such as that of 1880 (forty-nine days early) and that of 1894 (twenty-four days late).

IN a paper presented to the Astronomical and Astrophysical Society of America in January, and reprinted in abstract in the July Journal of the Washington Academy of Sciences, Mr. W. J. Humphrys, of the United States Weather Bureau, examines the question whether the presence of volcanic dust in the upper atmosphere is sufficient to account for the periods of abnormal cold which have at times been experienced simultaneously over the whole earth. He finds that the meteorological records from 1750 onwards show that cold periods were in every case preceded by volcanic eruptions, and that the greater the eruption the longer the period of unusual cold. In the case of the eruption at Krakatoa in 1883 the years 1884–5–6 were all 1° or 2° F. below the normal temperature. Measurements made at the U.S. Weather Bureau since 1883 show that dust in the upper atmosphere produced by an eruption may decrease by 20 per cent. the intensity of solar radiation received at the earth's surface.

OUR ASTRONOMICAL COLUMN.

A STAR WITH LARGE PROPER MOTION.—In *Astronomische Nachrichten*, No. 4674, Miss E. F. Bellamy directs attention to the large proper motion of Helsingfors 914, which was found when assisting the Vatican Observatory in the reductions of its portion of the Astrographic Catalogue (zones +65° to +55°). The star is close to Hels. 913, and since the seconds of R.A. in the Helsingfors Catalogue for 914 and 913 are 44·8s. and 44·2s., whereas in BD they differ by 5s., and the Vatican residuals also differed by nearly 5s., it was at first thought that there was a mistake in Helsingfors. Subsequent investigation showed that Hels. 914 had a considerable proper motion, the motions being +0·236s. and +0·36″ annually. Miss Bellamy points out that the centennial proper motion in arc of a great circle is +157·0″, the largest proper motion hitherto found in either the Oxford or Rome work, the next largest being 141·9″.

"GIANT" AND "DWARF" STARS.—In an address given at the meeting of the Royal Astronomical Society in June last, and reported in the current number of *The Observatory*, Prof. H. N. Russell presented a short account of the studies which have led him to adopt a theory of stellar evolution through stages of increasing and decreasing temperatures, as Ritter deduced from thermodynamical considerations and similar to the idea of a "temperature curve" which spectroscopic work led Sir Norman Lockyer to suggest represented the course of development of a stellar body from a sparse meteoritic swarm to a dense, feebly radiating, and dying sun. Briefly, by considering absolute magnitude (a function of mass, density, and surface brightness) and spectral type, Russell finds that there are no faint white stars; all the very faint stars are red, and among the reddest stars, K and M classes, there is a distinct separation into two groups, one much brighter, the other much fainter, than the sun. To explain the existence of the two kinds of stars, the "giant" and "dwarf" stars first noticed by Dr. Hertzsprung, recourse is made to the evidence afforded by double stars and eclipsing variables; from the former differences due to mass are eliminated, and from the latter the effects of variation of density are deduced. It appears that the series of dwarf stars is one of slowly increasing density from B to M, while among the giant stars density decreases very rapidly from B to M, and it is suggested that the giant stars of class M represent a very early stage of evolution, class B a stage near the middle, and the dwarf stars later stages according to increasing faintness and ruddiness. As a confirmation of the theory it is pointed out that the actual densities of the stars of class A and B are of the order of magnitude (one-tenth that of water) at which Lord Kelvin predicted temperature should be a maximum.

THE STATIONARY RADIATION OF METEORS.—The present position of this puzzling question in the field of meteoritic astronomy is discussed by Mr. W. F. Denning in the August number of *The Observatory*. The observational difficulties and possible accuracy of determinations of radiants are indicated. The reality of the phenomenon is insisted upon, and some of the unsatisfying explanations which have been offered by Greg, Ranyard, Proctor, Herschel, and Turner, among others, are briefly mentioned.

THE LANCASHIRE SEA FISHERIES LABORATORY.

THE twenty-first annual report of this laboratory contains an interesting record of the routine work and investigations carried on during 1912. The usual four classes for fishermen were held at Piel during the spring; fifty-two fishermen received instruction in marine biology, with special reference to the life-history and habits of fishes and the more common invertebrates captured in the trawl-net, and thirty-nine of the men attended also the course in navigation.

Mr. Johnstone continues his records of diseased conditions of fishes. He describes and figures a fibromatous tumour from a halibut, melanotic sarcomata in skate, and tubercular lesions in a cod. Piscine tubercle has been known hitherto only in freshwater fishes, and it is therefore of interest to find the present typical lesions in a fish living in the open and not likely to have become infected by land-drainage. Dr. Alexander contributes a review of piscine tubercle, and gives a description of an acid-fast bacillus found in the cod above-mentioned. The lesions were skin infections, resembling lupus, and containing typical tubercles. The organism was found to be non-pathogenic for the guinea-pig.

Mr. Johnstone gives a detailed report on the more important mussel-beds in Lancashire and North Wales in regard to their liability to sewage contamination. His investigations show that the mussels from certain areas, *e.g.* parts of the Conway and Lune estuaries, are objectionable as articles of food, and he urges the necessity for supervision of natural shellfish beds, in the interests not only of public health, but of the shellfish industry.

In his account of the measurements and variations in the condition of plaice, Mr. Johnstone suggests that the main cause of the periodic migrations made by plaice is change of temperature. The migration is of the nature of an adaptation to a change in the environment, the plaice responding by so moving that the temperature-change becomes minimal.

Mr. Riddell gives an account of the plankton collections obtained during 1912 in the Irish Sea. Prof. Bassett, in reporting on the water samples taken at the same time, points out that very high salinities prevailed throughout the year 1912, especially at certain stations on the line from Holyhead to the Calf of Man, due to the flooding of the English Channel and Irish Sea by water of Mediterranean origin. He briefly discusses the types of oceanic circulation in the North Atlantic, and concludes that there are corresponding meteorological conditions, and that the latter, in so far as they affect the succeeding summer, can be foreseen from the value and time of occurrence of the maximum salinities in the Irish Sea.

The intensive study of the plankton around the south end of the Isle of Man has been continued. The maxima of the diatoms and most other plankton groups were earlier in 1912 than 1911. Examination of the various forms of the diatom Biddulphia leads Prof. Herdman and his collaborators to regard *B. sinensis* and *B. regia* as two forms of the original species *B. mobiliensis*. Mr. Scott reports on the pelagic fish-eggs of this area, and Mr Jackson on the decapod larvæ.

Prof. Herdman and Mr. Riddell, in their report on the plankton of the west coast of Scotland, state that the phytoplankton, which was so widespread in July, 1909 and 1911, especially round Mull, seems in the last two summers, and particularly in August, 1912, to have become pushed back or restricted to the more land-locked waters by an unusual influx of characteristically oceanic organisms from the Atlantic, *e.g.* the copepods *Metridia lucens* and *Candacia armata*. It is suggested that in the Hebrides there is a definite connection between the presence of oceanic water containing the copepod Calanus in quantity and shoals of herrings, for large hauls of Calanus were, on several occasions, obtained at places where, either the night before or the night after, good catches of herrings were reported.

BRITISH FORESTRY.[1]

THE useful publication before us (though foresters have to mourn the death of its long-time editor) retains its high standard of excellence. At the annual general meeting of the society, instead of a formal address there was a discussion on the relation of forestry to agriculture, &c. It is sufficient to follow this discussion to see what a strong body of opinion exists amongst practical men—forest owners and foresters—in favour of a comprehensive scheme of national forestry. The conclusions arrived at in this discussion vary little from those expressed in the Coast Erosion report of 1908, and in the similar Committee reports that preceded it.

The average rental of hill grazing ground suitable for forest planting in the north-east of Scotland is not more than 1*s.* per acre. This fact opens up a great national question of the more profitable use of the land in these islands, which are themselves one of the most fertile and productive countries of the world. Then there is the question of small holdings. These are linked with forestry in the sense that they cannot generally exist under present conditions without the help afforded from winter labour in the forest. Looked at from a national point of view, the labour question means, in the case of grazing and shooting, two or three men employed per 1000 acres, against about 10*s.* per acre per year wages in forestry. The careful Prussian statistics give 11*s.* 4*d.* per acre per year as the average forest wages bill. About one man to fifteen is the grazing-*versus*-forest ratio given in the Coast Erosion Committee's report.

This rural labour, priceless from a national well-being point of view, is being lost to the country, and some 30,000,000*l.* is being sent out of the country yearly for timber and forest products which might be produced in these islands.

Says Mr. Munro Ferguson, commenting on the last forest Blue-book (Rept. of Advisory Com. on Forestry, Cd. 6713):—"While the Administration gropes its way in the dark, and while the paramount national interest of silviculture (as affording the widest scope for additional skilled labour on the land) is neglected, 3000 emigrants leave the Clyde weekly." Mr. Munro Ferguson was the first large forest owner in Scotland to bring his own woodlands under scientific management, and he has since then represented forestry in almost every capacity.

The full text is given of the address of Sir John Sterling Maxwell (the retiring president of the Royal Scottish Arboricultural Society) to the Aberdeen branch. This was summarised in the April number of the Quarterly Journal of the English Arboricultural Society. It may be looked on as the most important pronouncement, in favour of a comprehensive scheme of State forestry, that has yet been made by an influential owner of forests in these islands: It is well termed, "The Place of Forestry in the Economic Development of Scotland." No lover of trees, no one

[1] Transactions of the Royal Scottish Arboricultural Society, vol. xxvii. part ii., July, 1913. (Edinburgh: Douglas and Foulis.)

who wishes to see the scientific methods in vogue on the Continent brought to bear on the waste lands of these islands, should be without a copy of this illuminating address. It concludes with the statement that "the Belgian Government obtains on the capital it has invested in forestry a return varying from 4·9 to 5·5 per cent." In his retiring address as president (Proc., p. 10) he adds:—"Scotch forestry is in the toils of the serpent of red tape. In spite of our efforts to keep it free and independent, forestry is now entangled with a number of different departments, some of which in the nature of things can know very little, and perhaps do not care very much, about the subject."

Mr. B. Ribbontrop, who, for many years, was head of the Indian Forest Department, gives a summary of Dr. R. Albert's researches on the peat soils of north-west Germany.

The true character of the seedlings of Japanese larch raised from Scotch seed was discussed at last summer's meeting of the English Arboricultural Society. On one hand, the time (one generation) seemed too short for the environment to have altered so considerably the character of the seedlings. On the other hand, the alteration seemed to be too uniform for hybrids between *Larix europaea* and *Larix leptolepis*. Mr. A. Murray, writing from Murthly, where these seedlings have been closely watched from the first, now gives the opinion that they are not hybrids. It may be noted that a similar alteration has been remarked in the case of an Australian Eucalypt that had been one generation in southern France.

For extracting tree-stumps with gelignite, Dr. Lauder gives the following working formula:—For pine stumps, $\frac{\text{square of girth in feet}}{20}$ = cost in shillings of explosive; and for broad-leaved trees—oak, ash, elm, &c.—about double the cost of pines and firs.

THE MANUFACTURE OF ARTIFICIAL TEETH.

IN the *Bulletin de la Société d'Encouragement* for April last is an interesting and well-illustrated article on "La fabrication des Dents Artificielles Minérales," by M. Maurice Picard, of the firm of MM. Henri Picard and Co., read at the opening ceremony of the first factory established in France, at Versailles, in the presence of M. Lechevalier, the representative of the Minister of Commerce and Industry.

The making of artificial teeth has for more than fifty years been a small but important industry in England and America, where millions of teeth of many shades and shapes are annually manufactured.

This industry owes its origin and early development to illustrious Frenchmen. Pierre Fauchard, in his work, "Le Chirurgien-dentiste," 1728, first suggested the use of enamel. Duchateau in 1744 substituted porcelain for ivory, with the aid of the porcelain manufacturer M. Gerrard, of Paris. Later Duchateau, with Dubois de Chaumant, a dentist in Paris, who suggested the addition of pipe-clay, made great improvements in manufacture. The latter carried the invention to England, and obtained a patent in 1791 for fourteen years. In 1808 Fonzi, a dentist in Paris, fixed platinum pins into the body of the tooth, as a means of attaching the tooth to the artificial plate which holds it in position. M. Plantou manufactured artificial teeth in America in 1817.

Felspar and silica ground to an impalpable powder, to which is added a certain amount of kaolin, form the basis of all porcelain teeth. These are made into a thick paste, and tinted in a variety of colours with oxide of titanium. The paste is pressed into moulds in which are inserted platinum pins. These teeth are then fused in a furnace at a very high temperature. The factory in Versailles already manufactures 225,000 teeth each month.

Incidentally, one may inquire why such an invention should not have found, sooner, an industrial home in the land of its origin? The answer may be suggested, not in lack of enterprise, but in the facts that French people do not readily part with their natural teeth, and they have an innate objection to artificial teeth on plates.

We have no doubt that the refined foods of an advancing civilisation are leading to an increased destruction of teeth by dental caries. We have no evidence to prove that our neighbours' teeth, however, are better than our own, but they submit more readily to the conservative treatment which dentists are trained to give in the preservation of teeth, rather than permit the ravages of the *arracheur de dents*.

R. D. PEDLEY.

THE MUTATIONS OF OENOTHERA.

THE last decade has witnessed many remarkable advances in our knowledge of heredity and variation. The beginning of the present century may be said to mark the turning-point between the observational method of Darwin and the more intensively experimental method now pursued in the study of evolution. This change from observation to experiment in evolutionary study was participated in by many investigators. Among those whose work will ever occupy a prominent place in the renaissance of activity in scientific plant- and animal-breeding may be mentioned de Vries, whose theory of mutation, or the sudden origin of new species, has been a fruitful subject of investigation and discussion.

The views of de Vries, published in 1901, were based to a considerable extent upon his prolonged investigations with the evening primrose, *Œnothera Lamarckiana*. These now classic experiments showed that when this species is cultivated in large numbers, individuals appear sporadically but repeatedly year after year which differ from the type in nearly all their characters. These new types, or mutants, in many cases breed true, giving rise to new races, and the main facts of de Vries's observations have since been repeatedly confirmed.

It is safe to say that these remarkable and at that time unique observations have subsequently led to a more thorough and complete study of the evening primroses than has been accomplished in any other group of plants, not even excepting the garden pea of Mendelian fame. Numerous investigators have attacked the problem thus presented from many points of view, and much light has been thrown upon the general subject of mutations. This is particularly true of the cytological investigations, which have really furnished the key to the explanation of the mutation phenomena.

Since a fortunate discovery in 1906 indicated that various mutants differed in the constitution of their nuclei, the origin of these differences has been an absorbing subject of investigation. Two years later it was possible to show that a basis for changes in the nuclear constitution of different mutants exists in the germ cells, and that the process of mutation is probably in part a result of irregularities in chromosome distribution during meiosis or germ-cell formation. The chromosomes are the constituent parts of the nucleus, and their number is constant for each species, so this furnished the desired proof that, in some

of the mutants at least, a fundamental change in the structure of the nuclei had taken place, and that the external changes of characters in mutation had their origin in internal structural changes of the cells and their nuclei.

The premutation hypothesis, formulated by de Vries to account for the origin of the mutations before the facts regarding their cell-structure were known, assumes that new units gradually accumulated in the germ plasm of the species previous to the beginning of the mutation process, and that these afterwards passed from a latent to an active condition, thus producing the mutations. But since the structure of the nuclei in these forms is now known, and the manner in which changes in that structure originate, this hypothesis has been superseded, and the conception of a mutation period is no longer needed.

Various writers have also suggested that the mutations of Œnothera were merely re-combinations of characters, such as occur in Mendelian hybrids. This hypothesis is also contrary to our present knowledge of the nuclear structure and behaviour in Œnothera, and furnishes another instance, like that of the sex-chromosomes, where nuclear studies throw light upon the nature of the processes of heredity and variation. By combining the study of nuclear and cell structure with that of external characters, it is evident that much further insight into the nature of mutation and heredity may be gained.

A specific case of the type of germinal change here referred to is that of *Œnothera lata*. It has recently been found that when combined with characters derived by inheritance from various other forms (*e.g. O. biennis, grandiflora and rubricalyx*), the characteristic foliage and habit of *lata* is always accompanied by the presence of an extra chromosome in the nuclei of the plant, making the number of chromosomes fifteen instead of fourteen. In other words, this type of foliage is constantly associated with the presence of an extra chromosome.

Mutations are by no means confined to the evening primroses, but are now known, through experimental studies, to occur in bacteria, fungi, mosses, and many flowering plants. And among animals, instances of sudden and inherited departure from the parent form occur in various groups from Protozoa to man himself.

The new characters thus appearing form a varied and motley array, differing often in most unexpected ways from their parent types. Many of these mutations appear "spontaneously," that is, from unknown causes. These are probably often an indirect result of previous crossing, change of climate, &c. Others have been directly produced by a variety of experimental conditions. The study of the causes of these germinal aberrations and the manner of their production is evidently destined to play an important rôle in future experimental evolution. The results already achieved point to a wide and important field of research in the application of these methods to horticulture, agriculture, and experimental breeding.

R. RUGGLES GATES.

OBSERVATIONS IN THE SOUTH MAGNETIC POLE AREA.

I BEG herewith to enclose what I trust will prove for the scientific world in general an important preliminary report by Mr. E. N. Webb, magnetician to Dr. Mawson's Australasian Antarctic Expedition, on the magnetic work, and particularly the absolute readings taken by Mr. Webb himself on a very fine journey made by him and Mr. J. F. Hurley, under the leadership of Lieut. Bage, in the direction of the south magnetic pole for the distance of 300 miles to the south-east of Dr. Mawson's base at Commonwealth Bay in Adélie Land.

You will see that a large number of very valuable observations have been obtained on the north-west side of the south magnetic pole area, and these, when considered with the observations—fewer in number but accurate—taken by Dr. Mawson himself on the occasion of the Shackleton expedition on our approach on the south-east to the south magnetic pole area, should now enable the position of the south magnetic pole in 1912 to be calculated with a degree of accuracy considerably in advance of anything previously attained.

I have ventured to add some notes in reference to the observations made by Dr. Mawson in the party—consisting of Dr. Mawson, Dr. A. T. McKay, and myself—of which I was leader in a journey to the south magnetic pole area in 1908–9. I send with it a plan on tracing cloth showing the route followed by the Australasian Antarctic Expedition, with the positions of the stations where Webb made his observations.

T. W. EDGEWORTH DAVID.

University of Sydney, May 26.

MAWSON'S AUSTRALASIAN ANTARCTIC EXPEDITION.

Preliminary Report on Magnetic Work, by E. N. Webb, Magnetician.

Early in December of 1911 the Australasian Antarctic Expedition, under the leadership of Dr. Mawson, left Australia to carry out a programme of scientific investigation on the Antarctic continent.

It was intended to conduct a magnetic observatory at one base station, and to make a magnetic survey of the coast between Cape Adare and Gaussberg. A large portion of this plan was successfully carried out. Through the kindness of Dr. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington, D.C., the writer was trained during five months' field survey work in Australia, under Mr. E. Kidson, one of the department's observers.

Absolute instruments were lent by the Carnegie Institution, consisting of two unifilar magnetometers, one Kew pattern and one Lloyd-Creak dip circle, by Dover, Charlton, Kent, both fitted with 6 in. declinometer needles, and total intensity attachments.

Intercomparisons of all instruments with a set used by Mr. Kidson were made at Hobart before going south; also, the Eschenhagen magnetographs, comprising declination, horizontal and vertical intensity variometers, were set up under the direction of Dr. J. M. Baldwin, first assistant at Melbourne Observatory. Both the observatory and the field work at the main base were in charge of the writer. Field survey work was commenced at Macquarie Island, where determinations of the magnetic elements were made at two stations, one at the extreme north of the island, and the other at Caroline Cove. The average of determinations at the north end gave declination 18° 25′ E.; horizontal intensity, 0·13990; dip, 77° 47·8′ S. Leaving Macquarie Island, the expedition proceeded to Adélie Land, and at Commonwealth Bay in latitude 67° 0·0′ S., longitude 142° 39′ E., landed the main party. Here two magnetic huts were erected. In the larger, which was carefully constructed to resist wind and change of temperature, the magnetographs were set up with the frames on solid rock, and put in working order on March 21, 1912. Temperature-compensating systems were fitted to the H. and Z. variometers, and temperature effects have been almost entirely eliminated. Deflections were made once a fortnight for scale values.

In order to record the large declination changes (as high as 12°), a scale value of 2·25′ per mm. had to be employed, while the force ranges required a scale value of 8 to 10 γ per mm. The largest change in force occurred during an auroral storm, when a reduction of more than 1000 γ took place in horizontal intensity.

During the time of occupation a complete and accurate log of aurora was compiled. Between March and October, numerous displays were observed, varying from a dull nebulous glow low in the north to splendid designs of arches, curtains, and streamers vividly coloured in green, red, and heliotrope, far surpassing anything seen by Dr. Mawson in McMurdo Sound in 1908. The exact times of prominent phases were noted. A cursory comparison with the magnetograph records showed a remarkable coincidence of magnetic and auroral storms. The nebulous type of aurora seemed to have little accompanying magnetic disturbance, but when moving and coloured luminous bands scintillated across the sky, the phases of the accompanying magnetic storm would almost invariably be found to correspond to variations in form or colouring of the aurora. Three splendid displays in the evenings of July 4, 5, and 6 perhaps constituted the most brilliant series. There seemed to be some indication of a recurrence of aurora at definite intervals.

As previously arranged in a scheme of international cooperation, twenty-four special terms of two hours each were "quick run" on the magnetograph. These unfortunately proved wanting in incident, the most disturbed being that of April 16, 1912, when a fairly large movement was recorded.

From the end of March, 1912, to February 8, 1913, the magnetograph record is almost unbroken.

In the smaller hut absolute determinations of declination, horizontal force, dip, and total force were made once a week. The average values at the station were:—Declination, 6° 30′ W.; horizontal force, 0·0311 C.G.S.; dip, 87° 21·5′ S.

Observations often had to be carried out in winds of eighty to ninety miles an hour, and in a pitchy darkness, since the night hours were the only approximately calm ones magnetically.

As a check on the absolute hut station, an ice station was occupied during the winter in a cavern dug out of the glacier, half a mile distant. The difference between the two stations was trifling in all the elements. In the early spring Mr. Hannam was instructed in the conduct of the observatory, and later carried on all work there during the magnetician's absence on sledging journeys.

In early September, 1912, three reconnaissance parties were sent out. One full magnetic station was occupied 11½ miles south of winter quarters.

On account of the persistently furious gales, no start could be made on the long summer sledge journeys until the second week in November. Three main parties then got away, while a fourth was to move off in early December. Of these, one was to make a long journey east, and was provided with a theodolite trough needle for determining magnetic declination; a second was to explore the more adjacent eastern coast-line, and besides a three-inch theodolite with compass needle, carried a dip circle with two dip needles; a third party was to make a journey south along either a geographical or a magnetic meridian towards the magnetic pole; while the fourth, carrying a sextant and an improvised declinometer, was to make as far west as possible. All parties were to return not later than January 15, 1913.

The eastern coastal party, under Mr. C. T. Madigan, secured magnetic results at eight stations fairly distributed over 270 miles. Declinations were obtained with the 2-in. compass needle attached to the theodolite, and dips were determined with either one or two needles.

The third party, consisting of Lieut. R. Bage, (leader), J. F. Hurley (photographer), and E. N. Webb (magnetician), left winter quarters, Commonwealth Bay, on November 10, 1912, and was assisted by a supporting party. A 3-in. Cary theodolite was taken for astronomical observations, and for magnetic observations the dip circle with declinometer and total intensity attachment and four dip needles. Strong head-winds and heavy drift were met with throughout the following week, and, with heavy loads, the travelling, over *sastrugi* country, was very slow. On November 21, 67½ miles S. by E. from winter quarters, the supporting party left.

Magnetic observations indicated considerable local disturbance, so to get the advantage of a direct dip gradient to the magnetic pole, the magnetic meridian was followed as nearly as possible. In the course of the outward journey seven full magnetic stations were occupied at intervals of thirty to fifty miles, while, in addition, rough determinations of declination and dip were made at almost every camp.

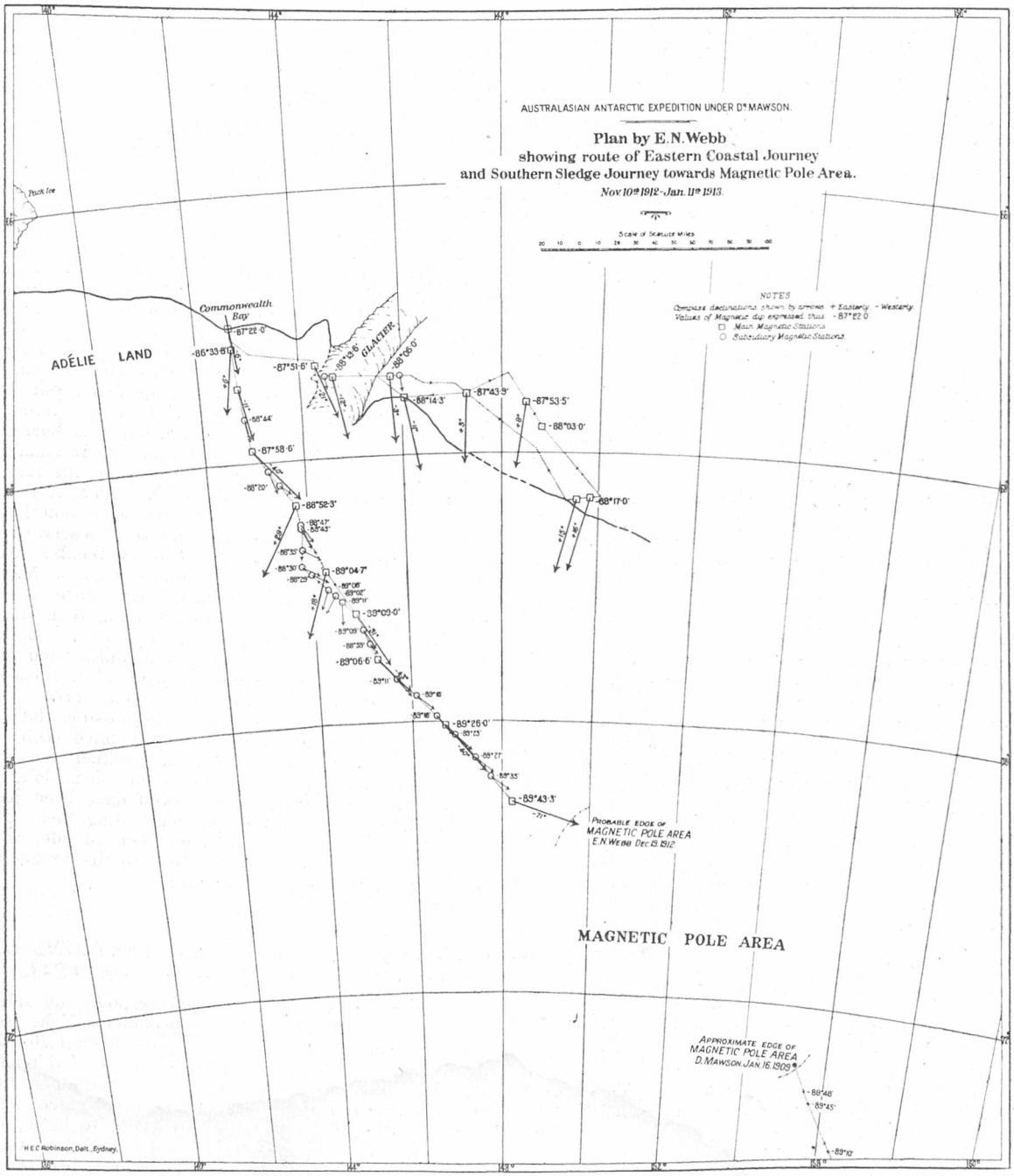
The observations at each full magnetic station comprised complete astronomical observations, observations of dip with four needles, double determinations with total force needles, and sixteen settings of the declinometer needle for declination. The declinometer trough needle proved an excellent instrument, even at the position of highest dip. Nearly all astronomical and magnetic observations were computed on the march as obtained.

For steering purposes on the journey a sun-dial or "shadow compass," computed for the sun's mean declination and equation of time, and the approximate mean latitude, was used. Granted clear weather, this is a very useful instrument. Steering south-east from the depôt, heavy head-winds were met with, the surface rising steadily and becoming rougher, with *sastrugi* increasing in size. At 100 miles and 174 miles out from winter quarters the party was held up by severe weather, but occupied itself with magnetic observations. Besides a full magnetic set at the 100 miles, a snow shaft 8 ft. deep was excavated, and a temperature gradient obtained, +9° F. at surface to −13° F. at 8 ft. At 174 miles a continuous observation of declination over twenty-five hours was made with the dip circle trough needle, the party living in a hole dug out of the snow.

On December 12 a depôt of food, oil, &c., was made at 200 miles. With the lighter sledge it was found that runs of from twelve to fifteen miles per day could be made. On December 21 the extreme station, 301 miles, was reached, at a height of 5900 ft. above sea-level, in latitude 70° 36′ S. and longitude 148° 12′ E. At most stations the magnetic meridian for dip observations was obtained by declinometer, but at this station dip was determined with four needles in two directions at right angles, and the meridian and true dip were thence computed; resulting dip, 89° 43·3′ S.; declination, 70° 49′ W.; total force, 0·6692 C.G.S. Between 200 and 300 miles out the surface was exceedingly rough, *sastrugi* 5 ft. high from trough to crest being met with.

Turning back on December 21, the first stages of the return journey were made more rapidly than had been expected, as much of the fresh snow had hardened. A depôt which had been laid at 200 miles on the out journey was picked up on December 27, and a full set of magnetic observations taken. During the remaining 200 miles almost continuous overcast weather obtained, making it extremely difficult to pick

up snow-mounds built at almost every camp on the way out. The 109-mile mound was picked up, but the only other one seen was the ninety-mile. On reaching the locality of the sixty-seven-mile depôt, there were only two and a half days' rations on hand, and the ration was immediately reduced. Short marches were made in various directions, but the



depôt could not have been seen 100 yards away, as light snow fell almost continuously.. On the evening of the second day a fair latitude and longitude were obtained from altitudes of the sun. The party moved on to the computed position of the depôt, but could see nothing. Next day, after a long wait, a noon latitude was obtained, and a movement was made towards the supposed position of the depôt, but without success. Under these conditions, with but one day's ration in hand, it was decided to depôt all gear not essential to safety, and make a dash for the coast. The dip circle had to be left behind, but the needles were brought on.

The next two days continued heavily overcast, while a strong blizzard wind with thick drift was experienced. The third day was much brighter, and, with infinite relief, the party reached the depôt five miles from winter quarters just after midnight.

During the whole journey complete meteorological observations were made every two hours, and minimum temperatures were obtained at night. Altitudes

were obtained by aneroids, standardised by a hypsometer.

The only life seen consisted of two snow petrels at eighty miles, and a skua gull at 125 miles, while no sign of rock was seen.

Longitude observations at three stations on the outward march were repeated on the return, so that the chronometer rate over three sections could be determined, giving good final longitudes.

Between 100 and 200 miles strong magnetic disturbance was evident. Declination chopped round by 90° in as short a distance as ten miles, while reversion of dip gradient was very commonly experienced. From 200 to 300 miles the declination was much more constant, and a steady dip gradient was observed. Continuing this last fair gradient, the 300-mile station was probably about forty miles from a position of maximum dip.

At the extreme western base 200 miles east of Gaussberg, and 1100 odd miles distant from the main base, magnetic conditions were better, but weather conditions were harassing. No magnetographs were provided, but periodic absolute observations were to be taken by the magnetic observer, Mr. A. L. Kennedy. Observations with magnetometer and dip circle were taken when possible. The station was situated on a floating glacier or barrier, and during the year determinations of the azimuth of the mark showed a progressive movement. During the sledge journeys—as far as Gaussberg in the west, and for 150 miles to the east—declinations were obtained at intervals with a prismatic compass, or with a declinometer attachment to a Lloyd-Creak dip circle. Two sets of dip were obtained on the eastern journey.

Term days were kept at the western base when possible by continuous eye readings of declination, while auroræ were observed and several observations of declination taken during active auroral disturbance. The accompanying plan shows most of the declinations and dips obtained. The possibilities of highly disturbed areas are illustrated by the anomalous declinations and dips about 100 to 174 miles. At 132 miles heavy crevasses were found, which seemed to indicate some unconformity beneath the ice-sheet.

Notes by Prof. Edgeworth David.

I have only just received by wireless some of the actual dips obtained by Dr. Mawson with a Lloyd-Creak dip circle other than those already published in Shackleton's work, "The Heart of the Antarctic."

First, at the Nordenskjöld ice-barrier, lat. 76° 14′ S., long. 163° 9′ E., the dip was found to be 88·1° S.; at the Drygalski Ice Barrier Tongue, in lat. 75° 28′ S., long. 163° 15′ E., the dip was 87·5°. On the Reeves Glacier, in lat. 74° 48′ S., long. 161° 30′ E., it was 87·9°. All these three sets of observations were very carefully taken. Again at lat. 73° S., long. 156° 10′ E., a careful set of observations showed the dip to be 89° 10′. The next observation, which may not be looked upon as quite so accurate as the others, gave the dip as 89° 45′, in lat. 72° 42′ S., long. 155° 40′ E., and the last observations, also of approximate accuracy only, indicated a dip of 89° 48′, at a spot thirteen miles to S. 30° E. of our furthest point to N.W., the latter being in lat. 72° 25′ S., long. 155° 16′ E.

When we reached the spot where we recorded a dip of 89° 45′, on January 15, 1909, Mawson concluded that as the rate of change of dip had considerably increased in the last twenty-five miles we were close to the edge of the area of the vertical needle. The evening of the same day, when seven miles nearer the south magnetic pole area, Mawson's measurements gave the dip as 89° 48′. On striking a curve, he estimated that the actual edge of the region of verticity was only about thirteen miles distant from where our dip of 89° 48′ was recorded. We had already travelled twenty-seven miles beyond the spot where the results of the *Discovery* observations had placed the south magnetic pole during 1902–3. Accordingly we determined to march on thirteen miles and put up the flag there, as being the edge of the area of the vertical needle. Our proceedings have already been described in vol. ii., "The Heart of the Antarctic," pp. 180–2. During these last thirteen miles we took no observations with the dip circle, the tripod of which we utilised as a mark to guide us back on our return march.

Mawson estimated that the position of our furthest point to the north-west was in lat. 72° 25′ S., long. 155° 16′ E. A short distance on our return from the spot considered to be the edge of the area of vertical needle, Mawson experimented with the horizontal needles of an ordinary prismatic compass and a Brunton transit instrument. While he considered both needles worked "dead"—that is to say if the compass boxes were twisted the needles followed them around—it was found that on tapping the boxes and making the needles spin, the more sensitive of the two showed a slight tendency for its south-seeking end to come to rest within the western hemisphere of the compass. Mawson felt satisfied at the time that even if we might not have been within the area of vertical needle, at the particular moment—about 3.30 p.m., on January 16, 1909—when the end of our journey was reached, we were still well within the region of the diurnal swing of that area. In view, however, of the recent remarkable observations by Mr. E. N. Webb, it seems doubtful whether there may not have been some local disturbing influences affecting Mawson's observations on the Shackleton expedition, such as Webb's map shows affected the magnetic observations of Mawson's present Antarctic expedition. Reference to the map will show that at several spots along their route declination varies to the amount of from 40° up to 69° within a distance of only a few miles, and the dip, in some places, lessened considerably, instead of increasing, as the magnetic polar area was approached. This suggests that it is possible that at our furthest point north-west we may have been on the edge of either a local pole, an "outlier" of the main south magnetic polar area, or on a local lobe of the magnetic pole area, or may even have been just outside an area of absolute verticity altogether. By how much, if at all, we may have been outside, can, of course, only be determined when all the magnetic results are reduced, and compared.

MEROË: FOUR YEARS' EXCAVATIONS OF THE ANCIENT ETHIOPIAN CAPITAL.[1]

ON behalf of the University of Liverpool, and aided by the support of private benefactors, the lecturer has been at work for four years in scientifically uncovering the ruins of the once-famous Ethiopian capital. When his first expedition arrived upon the scene, there was little to suggest the great extent and interest of the city which has now come to light; in fact, only one wall and a few objects of sculpture were visible above the soil. Now, however, a number of temples, palaces, and public buildings have been laid bare; the walls of the royal city have been traced; and during the past season's work, from which the lecturer has just returned, a considerable portion of this enclosure has been excavated so that a visitor may enter by the city gate and walk along the ancient

[1] Summary of a discourse delivered at the Royal Institution on Friday, April 25, by Prof. John Garstang.

streets, turning right or left at will into the different buildings.

First amongst the greater buildings of the site is the Sun Temple, which is designed in a series of ascending ambulatories with stone-built cloisters, the sanctuary being found on the highest platform, in the middle. A contemporary representation of the building upon its own walls has enabled Mr. W. S. George, the able architect of the expedition, by comparison with actual measurements, to attempt a reconstruction. In character and situation this temple corresponded to the "Table of the Sun" mentioned by Herodotus. An even larger building is the Temple of Ammon, the main axis of which is 430 ft. in length; the high altar and the special enclosure for sacrificing animals, and other interesting features of the temple, are well preserved. Other monuments excavated include an extensive palace presumed to be of Roman period, two small temples, one of which was dedicated to a lion-deity, an ancient temple of Isis, later reconstructed, pottery kilns of Meroitic times, and several hundred tombs of the necropolis. All these features appear to have been outside the chief, or royal enclosure, and it appears that there is still untouched by the excavators' spades a much larger area than has yet been attacked, including the ancient township itself which abutted against the walls of the royal city. The explorer is of the opinion that without a substantial increase in the annual sum available for this work, which up to the present has been almost entirely privately contributed by a few generous benefactors, it will scarcely be possible to complete the undertaking even in ten or fifteen years.

For the last two seasons the excavation has been almost entirely concentrated upon the royal enclosure, in which remarkable discoveries have been made. In one of the royal palaces a hoard of gold treasure and ornaments was found; and the royal baths adjacent, which are on an extensive scale, illustrate in their details the character of the Meroitic arts better than any other features of the city.

Under the threshold of another public building, carefully buried in sand, amid the débris of a building, there was found a beautiful bronze head of Augustus, which is now permanently deposited in the British Museum. A short distance from the spot are the remains of a small temple of Roman style; and the lecturer believes that this bronze head of the divine emperor had once formed the cult object in this temple. Two passages from Pliny seem to have been overlooked by those who have discussed the possibility of a Roman occupation at Meroë. From these it would appear that the imperial soldiers under Petronius had not only reached Meroë, but had passed up the Nile a further 100 miles. During the past winter a bronze coin of Augustus and an increasing number of small objects were discovered, all of which tend to indicate that, for a brief time at any rate, Roman troops actually occupied the city. In this way the fact and circumstances of the discovery of the bronze head would be satisfactorily explained. When Augustus commanded the Roman troops to withdraw, the head was removed from the temple and carefully buried out of danger of violation.

Two main culture periods are traceable in the history of Meroë previous to the Roman occupation. The first was that of its foundation under King Aspelut and his contemporaries, about the seventh century B.C. In this period Egyptian influence in art is freely apparent. The second phase began with an influx of Greek ideas, which may be roughly dated to the third century B.C., corresponding to a record by the historian Diodorus of great reformations instituted by Ergamenes, who had himself been educated in Greek thought in the schools of Alexandria. It is the second phase which is the most striking in the history of Meroë, and most of the visible buildings and monuments of the site belong to this period. The Roman occupation left little permanent impress upon the civilisation of the locality, but previous and subsequent to the expedition of Petronius there must have been already some influence of Roman contact, which manifests itself in various ways.

Thereafter the history of Meroë became that of a local and somewhat barbarous civilisation, reflecting only faintly the Greek and Roman culture with which it had been earlier infused. A record of the fourth century A.D. tells us how it was sacked by a king of Axum; but as late as the seventh century it would appear that invaders from the same district (Eritrea) overran the city and threw the statues and pictures of the gods into the river.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—An important announcement was published on August 13, to the effect that the President of the Board of Education has appointed a Departmental Committee to inquire and report, after consultations with the bodies and persons concerned, as to the steps by which effect shall be given to the scheme of the report of the Royal Commission on University Education in London, and to recommend the specific arrangements and provisions which may be immediately adopted for that purpose, and as the basis for the necessary legislation. Sir George H. Murray, K.C.B., who was formerly at the Treasury, and later Secretary to the Post Office, has been appointed chairman of the Committee. The other members are Sir Amherst Selby-Bigge, Secretary to the Board of Education, Sir John Rose Bradford, Sec.R.S., Sir William MacCormick, Dr. George Franklin, Dr. Arthur Keith, Mr. John Kemp (one of the secretaries to the Royal Commission), and Mrs. Henry Sidgwick. Dr. Frank Heath, the other secretary to the Royal Commission, is appointed secretary to the Committee.

MANCHESTER.—The council of the University has appointed Dr. A. D. Imms to the newly created post of reader in agricultural entomology. Dr. Imms was formerly professor of biology in the University of Allahabad, and afterwards forest entomologist to the Government of India at the Imperial Research Institute, Dehra Dun. He will be in charge of the researches in agricultural entomology conducted under the scheme approved by the Board of Agriculture and Fisheries. The council, with the assistance of a grant in aid from the Development Fund Commissioners, has provided special laboratory accommodation for these investigations, and will undertake the necessary provision for the work of the department.

A REUTER message from Melbourne reports that a pioneer colonist named Mr. W. Robbie has died at Ballarat, aged ninety-one years, and has bequeathed 30,000*l.* to Aberdeen University to establish scholarships.

THE vacancy in the directorship of the Agricultural College at Cornell University, caused by the resignation of Prof. L. H. Bailey, has been filled for the time by the appointment of Prof. W. A. Stocking, jun., as acting-director for a term of one year. Prof. Stocking is forty-one years of age, and has been a member of the faculty of the college since 1899.

THE Governor of Pennsylvania has, we learn from *Science*, approved the following State grants made at the last session of the legislature:—The Pennsylvania

State College, 248,000*l.*; University of Pennsylvania, 164,000*l.*; University of Pittsburgh, 80,000*l.*; and Temple University, 20,000*l.*, making the total State grant for higher education 512,000*l.* From the same source we learn that Franklin College, Indiana, has secured pledges amounting to 50,000*l.* for additional endowment. Three-sixteenths of this amount is from the General Education Board in the United States.

THE Edinburgh Mathematical Colloquium was held during the first week of August in the mathematical department of the University. It was organised by the office-bearers of the Edinburgh Mathematical Society in response to a widely expressed desire on the part of mathematical teachers in England for a vacation course in the mathematical laboratory which Prof. Whittaker was instituting. In addition to five lectures by Prof. Whittaker on the periodogram and harmonic analysis, two other courses were provided. Prof. Conway, of University College, Dublin, lectured on the theory of relativity and the new ideas of space and time, and Dr. Sommerville, of St. Andrews, lectured on non-Euclidean geometry and the foundations of geometry. Nearly eighty members of the colloquium assembled from all parts of the United Kingdom, and two or three from Canada and the United States. The colloquium was in every way a great success, the novel features being the method by which Prof. Whittaker proposed to carry on the practical instruction in numerical evaluation of functions and the treatment of definite data. Each "student" sat at a specially designed desk for facilitating numerical work.

THE calendar of the Edinburgh and East of Scotland College of Agriculture for the session 1913–14 has now been issued. It contains full details of the various courses of instruction which are now available in the departments of agriculture, horticulture, and forestry. The aim of the college is to supply such training in agriculture and the sciences underlying it as is indispensable to all who intend to gain their living from the land as owners, or tenants, or agents. The calendar gives full guidance as to the curricula for the B.Sc. degree in agriculture and in forestry, the college diploma in agriculture, and the college certificate in horticulture. Special note may be made of the new course in horticultural science, which will appeal to young gardeners who have served their apprenticeship in the ordinary way, but desire to make themselves acquainted with the scientific as well as the practical aspects of horticulture. Under arrangement between Edinburgh University and the college there is now provided at Edinburgh a course of training in forestry. The preliminary course is intended specially for those who desire to get a knowledge of forestry for general purposes, and mainly from the practical point of view.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 25.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. F. **Oswald**: The Miocene beds of the Victoria Nyanza and the geology of the country between the lake and the Kisii highlands; with appendices on the vertebrate remains, by Dr. C. W. **Andrews**; on the non-marine Mollusca, by R. B. **Newton**; and on the plant-remains, by Miss N. **Bancroft**. The Miocene beds of the eastern coast of the Victoria Nyanza, south-east of Karungu, form a narrow zone (covered with black earth) at the foot of cliffs of overlying nepheline-basalt, and are only exposed in a few gullies. The whole series is conformable, dipping 8° north by west. 1 (Beds 1–12). An upper group (about 70 ft. thick) of grey and brown clays and shales, with occasional current-bedded sandstones containing terrestrial shells (Tropidophora, Cerastus), as also calcified tree-stems in the uppermost bed. 2 (Beds 13–25). A middle group (about 30 ft. thick) of red and grey clays, with white sandstones in the lower half. No bone-bed, but fragmentary Chelonian and crocodilian remains occur sparsely throughout the series. Persistent horizons are a travertinous marlstone (No. 14) containing Ampullaria and Lanistes; a thin sandstone (No. 16) yielding Hyracoid jawbones; and a gravel (No. 24) yielding teeth of Dinotherium, Protopterus, crocodile, &c. 3 (Beds 26–37). A lower group (about 35 ft. thick) of current-bedded sandstones and gravels passing down into clays and marlstones. A conglomerate of calcareous nodules overlies gravelly sandstones (No. 31) containing isolated bones of Dinotherium, Anthracotheroids, rhinoceros, giant tortoises, &c., indicating a Lower Miocene (Burdigalian) age, with Ampullaria, Cleopatra, and terrestrial shells (Cerastus). The vertebrate remains described by Dr. C. W. Andrews include Proboscidea, Hyracoida, Artiodactyla, Rodentia, and Reptilia, and fully support the suggested occurrence of Lower Miocene deposits on the shores of the Victoria Nyanza. A deposit of probably Pliocene age yielded a new (?) species of Elephas, also bones of antelopes and baboons. The non-marine Mollusca associated with the Miocene vertebrates are freshwater and terrestrial shells which all belong to existing species.

PARIS.

Academy of Sciences, August 11.—M. J. Boussinesq in the chair.—M. **Baillaud** gave an account of the recent meeting of the fifth congress of the International Union of Solar Research, held at Bonn.—L. E. **Bertin**: Concerning the origin of the double oscillograph for the simultaneous registration of pitching and rolling of ships.—A. **Lacroix**: The cipolin marbles of Madagascar and the associated silicate rocks.—A. **Romieux**: An attempt at gehypsographical exploration.—A. **Guillet** and M. **Aubert**: The direct expression of electrospherical functions; formation of differential equations verified by these functions.—E. **Rothé** and M. **Guéritot**: A method permitting the use of apparatus on a reduced scale in wireless telegraphy.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by some acids of the ethylene series. In the acids studied the double bond produces an increase in the absorption of ultra-violet rays, and this increase is the more marked as the position of the double bond approaches the carboxyl group. Geometrical stereoisomers present different absorptions.—H. **Giran**: The molecular weight of sulphur trioxide. By the application of Trouton's formula, as modified by M. de Forcrand, the molecular weight of sulphur trioxide has been found to be 80, that is the simple formula SO_3 of the gaseous anhydride.—J. **Bougault**: Phenyl-γ-oxycrotonic acid.—A. **Wahl** and P. **Bagard**: The microscopical examination of coals. The chief difficulty has been the choice of a suitable etching material for the coal sections; pyridine was used with success for bringing out details of structure.—L. **Lindet**: The influence of calcium chloride on the curdling of milk.

CAPE TOWN.

Royal Society of South Africa, July 16.—The president in the chair.—R. **Broom**: Some fossil fishes from the diamond-bearing pipes of Kimberley. This paper describes three new types of Palæoniscid fishes now preserved in the McGregor Museum, Kimberley, for

which the author erects two new genera—Disichthys and Peleichthys—and three new species—*Acrolepis addamisi, Disichthys kimberleyensis,* and *Peleichthys kimberleyensis*. The fossils occur on slabs of sandstone which were taken from the Wesselton and De Beers Mines, and from the absence of conspicuous sandstones in the Ecca beds of the vicinity, and the occurrence in another slab of *Chelyoposaurus williamsi,* they are in all probability of Beaufort age. Denudation has removed all trace of the parent rocks from the locality.—W. A. D. **Rudge**: The daily range of atmospheric potential gradient at Bloemfontein and the influence of dust storms. An account is given of observations at Bloemfontein between July and December, 1912, with a Bendorff recording electrometer. The values of the potential gradient at hourly intervals are given for the whole period, and curves showing the daily range of the potential gradient are given for selected cases. These curves show (1) the normal range on clear calm days; (2) that on days when some dust was observed; (3) that on very dusty days; and (4) some special cases. The normal curves are similar to those taken in other parts of the world, but those for dusty days show great differences. In class (2) the dust is present in quantity sufficient to keep the potential almost at zero whilst in (3) for a considerable part of the day there is a very strong negative potential gradient amounting to thousands of volts per metre. This negative result is caused by the clouds of fine siliceous dust raised by the wind, as has been shown by the author in previous communications. A negative potential gradient was never recorded unless dust was blowing or rain falling. Wind alone had practically no influence. The rain which fell during the period under observation was invariably negatively charged.—J. C. **Beattie**: Further magnetic observations in South Africa. Results of observations in various parts of South Africa during 1910–13. The greater number of the observations was carried out in the western Transvaal, British Bechuanaland, and Bushmanland. In addition a number of repeat stations were re-occupied.—J. C. **Beattie**: Magnetic maps of the western and northern parts of the Union of South Africa and of Great Namaqualand for the epoch July 1, 1908. Maps are given showing the true isogonics, the true isoclinals, and the true lines of equal horizontal intensity for the above region.—T. **Muir**: Note on Clebsch's theorem.

BOOKS RECEIVED.

The Microtomist's Vade-Mecum. By A. B. Lees. Seventh edition. Pp. x+526. (London: J. and A. Churchill.) 15*s*. 6*d*. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 47–53. (Jena: Gustav Fischer.) 2.50 marks each.

Le Froid industriel. By Prof. L. Marchis. Pp. 328. (Paris: Félix Alcan.) 3.50 francs.

A Plea for the Younger Generation. By Cosmo Hamilton. Pp. 63. (London: Chatto and Windus.) 2*s*. 6*d*. net.

Coast Erosion and Protection. By E. R. Matthews. Pp. xiv+147+32 plates. (London: C. Griffin and Co., Ltd.) 10*s*. 6*d*. net.

A New School Geometry. By R. Deakin. Part ii. Pp. viii+161–292. (London: Mills and Boon, Ltd.) 1*s*. 6*d*.

The Theory and Design of Structures. By Ewart S. Andrews. Third edition. Pp. xii+618. (London: Chapman and Hall, Ltd.) 9*s*. net.

General Chemistry Laboratory Manual. By Prof. J. C. Blake. Pp. x+166. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. net.

The English Convict: a Statistical Study. By Dr. C. Goring. Pp. 440. (London: H.M. Stationery Office; Wyman and Sons, Ltd.) 9*s*.

A Text-Book of Biology. By Prof. W. M. Smallwood. Pp. 285+13 plates. (London: Baillière, Tindall, and Cox.) 10*s*. 6*d*. net.

Die Physik der bewegten Materie und die Relativitätstheorie. By Dr. Max B. Weinstein. Pp. xii+424. (Leipzig: J. A. Barth.) 17 marks.

The Principle of Least Action. By P. E. B. Jourdain. Pp. 83. (London and Chicago: Open Court Publishing Co.) 1*s*. 6*d*. net.

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