THURSDAY, OCTOBER 14, 1909.

## SOME BOTANICAL BOOKS.

(1) *Die Pflanzenwelt Deutschlands.* By Dr. P. Graebner, mit Zoologischen Beiträgen von F. G. Meyer. Pp. xi+374. (Leipzig: Quelle und Meyer, 1909.) Price 7 marks.

(2) *Pflanzenbiologie. Schilderungen aus dem Leben der Pflanzen.* By Dr. W. Migula. Pp. viii+352. (Leipzig: Quelle und Meyer, 1909.) Price 8 marks.

(3) *Unsere Zierpflanzen. Eine zwanglose Auswahl biologischer Betrachtungen von Garten und Zimmerpflanzen sowie von Parkgëholzen.* By P. F. F. Schulz. Pp. viii+216. (Leipzig: Quelle und Meyer, 1909.) Price 4.40 marks.

(4) *Phanerogamen. Blütenpflanzen.* By Prof. E. Gilg and Dr. R. Muschler. Pp. 172. (Leipzig: Quelle und Meyer, 1909.) Price 1.25 marks.

(5) *Kryptogamen.* By Dr. M. Möbius. Pp. iv+164. (Leipzig: Quelle und Meyer, 1908.) Price 1.25 marks.

(6) *Zimmer- und Balkonpflanzen.* By P. Dannenberg. Pp. vi+160. (Leipzig: Quelle und Meyer, 1908.) Price 1.25 marks.

(7) *Clay's Successful Gardening.* Fourth Edition. Pp. 275. (London: Clay and Son, Stratford, n.d.) Price 9*d.* net.

(8) *Botany for Matriculation.* By Dr. F. Cavers. Pp. viii+568. (Cambridge: University Tutorial Press, Ltd., 1909.) Price 5*s.* 6*d.*

(9) *Beginners' Botany.* By Prof. L. H. Bailey. Pp. ix+208. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 3*s.* 6*d.*

(10) *Elementary Practical Botany.* By W. E. Clarke. Pp. xii+311. (London: The Normal Press, Ltd., n.d.) Price 3*s.* 6*d.* net.

(1) DR. GRAEBNER deals with the plant-world of Germany from an ecological standpoint, and thereby provides one of the first works on ecology confined to the limits of a single country. The subject of ecology is still in its infancy, and it is probable that it may gain stability when it is considered from a national rather than an international outlook. The difficulty in reducing ecological facts to a system, as the author points out, arises from the complexity of factors which influence the being of a plant. Dr. Warming bases his classification on soil conditions, but Dr. Graebner selects a more arbitrary standard, as his main divisions depend primarily upon the favourable or unfavourable characters of natural conditions, and, secondarily, on the modifications produced by special agencies, such as seasons or man. The arrangement works out better than might be expected. The first section is that of tropophilous formations found on sunny hills, on rocks and inland dunes. The second comprises formations on cultivated land. The succeeding sections refer to meadows, woods, river banks, plankton and aquatic vegetation. Finally, the author relegates heath and halophytic formations to separate categories. The two most prominent sections are those devoted to formations on cultivated land and to woods or forests. Under the former are gathered the vegetation of waste places (*Ruderalstellen*), fields and gardens, lawns and roadside trees. The importance of this section is extremely great, not only because of its extent, but because it lies immediately at our doors. Obviously the effect of human influence does not stop here, but the limit is that of man's most determined struggle to turn nature to his immediate purpose.

Under each section the author discusses the predominant factors, also any well-marked modifications, and describes the typical plant-formations with reference to their adaptations for nutrition and reproduction. The notes on animal life contributed by Mr. F. G. Meyer are added as postscripta to the sections. The book is a very desirable acquisition to the scanty literature on ecology, and can be recommended both for the philosophic argument of principles and causes, and also for the details. It also suggests the thought that there is a good opportunity for preparing a book on similar lines dealing with vegetation in the British Isles.

(2) The scope of Dr. Migula's "Plant Biology" is considerably wider than the preceding. It treats of bionomics as exemplified by reproduction and dissemination of plants, protective modifications and adaptations to external conditions; this leads to plant associations, and biology of nutrition precedes the description of federations between different plants, or plants and animals. It is, of course, impossible to deal comprehensively with these various subjects, and the author has merely endeavoured to present interesting sketches of plant-life. There is no striking originality in the early sections, but the author imparts his information in a clear and effective manner, notably in the introduction dealing with development, or, to put it more popularly, Darwinism. The chapters on adaptations of plants to climate and soil are in some respects the most attractive, as the author has elaborated these themes more fully. Plant communities are described under the divisions of forest, grass vegetation, heath and moor. Reference should also be made to the succinct accounts of root tubercles in the leguminous family, and the relationship between plants and ants.

(3) The horticulturist who is a deep thinker must often be puzzled to understand the idiosyncrasies of many plants that come under his care, even of stock plants in cultivation. For instance, how many can offer an opinion on variegation in a begonia-leaf and say how far it can be modified, or can explain why a pelargonium thrown on the dust-heap will retain its vitality for a long time? Further, there are the manifold variations in stem and leaf, the devices for pollination, and many other biological features which are not readily explicable even by those who have received technical training. To those who are anxious to gain an insight into these problems the book by Mr. P. F. F. Schulz will certainly appeal. He has wisely limited his notes to about fifty kinds. Plants in general cultivation are represented by begonias, the dahlia, perennial lupines, Aspidistra, sunflowers, and common ferns. Sauromatum, Aristolochia, and

various cacti are included because of their peculiar character, while the tulip tree and tree of heaven recall the plantations which beautify so many German towns.

(4, 5, 6) The next three volumes of which the titles appear above are units in a series of neat brochures dealing with all branches of knowledge. The publishers are entitled to great credit for bringing out such a series at the modest price of one mark per volume, as they have enlisted competent authors to deal with the various subjects. It may, however, be suggested that some of the volumes deal with subjects of too extensive a nature to be satisfactorily compressed within the limits permitted. The account of phanerogams, a systematic compendium, prepared by Drs. E. Gilg and R. Muschler, provides a case in point. About 120 families are dealt with in as many pages, with the result that there is only a bare reference to the botanical characters of each family, while the space is occupied by a mere enumeration of the more important plants and their properties. The same criticism applies to the volume on cryptogams, in which Dr. Möbius has made good use of the space at his disposal, but it is evident that each of the four groups of algæ, fungi, mosses, or ferns might with advantage have been taken separately. The cultivation of plants in living rooms and on balconies is a subject better suited to these small volumes, on which Mr. P. Dannenberg provides an interesting and useful book, essentially German as regards the minuteness of detail. Advice is given on methods of arrangement, ornamental pots, watering, pruning, transplanting, and propagation; also a useful list is supplied of plants suitable for growing at different seasons and under different conditions. Precise, accurate, and well arranged, the book admirably fulfils its purpose.

(7) A different type of floricultural book is that issued by Messrs. Clay and Son, primarily intended to advertise their special manures. The list of contributors includes Messrs. J. Hudson, J. Douglas, J. Udale, H. J. Wright, and E. H. Jenkins, who contribute articles on fruit-culture, carnations, begonias, sweet-peas, daffodils, and lilies. Sections are devoted to vegetable cultivation, indoor gardening, rock gardens, and garden pests. The volume contains much practical information for the cultivator, and more particularly for the grower of produce.

(8) It is not very long since Dr. Cavers produced a very successful elementary botanical text-book under the title of "Plant Biology," in which he indicated the methods adopted with his classes, and outlined a large number of experiments intended to instruct the student by his own personal observation and experiment. The success of this book and of "Life-histories of Common Plants" has presumably led to the compilation of the volume now under notice, which in many respects resembles the earlier books. Physiology is made the groundwork of preliminary study and explanatory of morphology; classification is dealt with in the descriptions of selected families, and a chapter is devoted to ecology. The range of the book is very much wider than is necessary for a matriculation course, although this is no disadvantage, as a teacher can select the portions immediately necessary. At the same time, many of the chemical and physical paragraphs might have been omitted, also the final chapter on the uses of plants. Apart from these criticisms, the book deserves the highest commendation, chiefly because the author conveys his information in a precise and well-ordered manner. The numerous experiments scattered through the text are admirably chosen to illustrate the points under discussion or observation, and for the most part require only simple apparatus.

(9) There is always a fund of originality in any book written by Prof. L. H. Bailey, and teachers will meet with not a few fresh ideas in his latest production. The opening is original, although Darwinian, that no two plants or parts are alike, that there is a struggle for life, and that the fittest survive; then follow chapters on plant societies and the plant body, after which ensues the ordinary gamut of elementary morphology, but treated in a fresh and inviting fashion. Another essential feature, also characteristic of the author's style, is the concise method of indicating facts or points without superfluous details; and finally it will be observed that the author introduces practical examples, so far as possible, as in the excellent chapter on bud propagation. The illustrations are bold, practical, and artistic. The studies in cryptogams, forming almost an appendix, do not make a very desirable addition, as they are perforce scrappy and introduce facts altogether beyond the scope of a beginner.

(10) The elementary practical book prepared by Mr. Clarke begins with external morphology and passes on to physiology, with the inclusion of chapters on soil, garden vegetation, distribution and cell structure. The experiments are collated in a separate part, and some account is given of selected flowering plants. Appendices are devoted to hints on the microscope and certain principles of chemistry and physics. It is apparent that the author has attempted to compress too much material into the book, more especially as he does not display that happy faculty of expression which combines conciseness with brevity; further, the information is somewhat ill-assorted, and there is a tendency to introduce ideas which are only partially relevant to the subject under discussion. There are also some inaccuracies, as in the use or explanation of various terms, such as pollarding, block, sucker, ivy root-tendrils and monosexual.

## *CLAYWORKING IN THE UNITED STATES.*

*History of the Clayworking Industry in the United States.* By Dr. H. Ries and H. Leighton. Pp. ix+270. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 10*s.* 6*d.* net.

FEW realise the important *rôle* played by clay in the industries. It certainly ranks not lower than fourth in the value of its production in the mineral industries of the world, and it is only exceeded by iron and coal, and possibly copper. Very few industries, too, are not dependent in some way upon clay

products. Every advance in the quality of these products has been followed by advances in other industries. The raising of the refractory qualities of fire-bricks, for example, gives the metallurgist greater power and scope, and the success of the electrochemical industries is to a large extent dependent upon the capability of the potter.

Considering the importance of the subject, the list of books with trustworthy information is surprisingly small. We therefore turn with pleasure to the present work, which is a history of the various branches of the clayworking industry in the United States, from the building of the brick houses by the early colonists up to the close of 1907. Consequently, there is no more than a passing reference to the very curious pottery fashioned by the aboriginal Indians. The book is compiled from statistics collected in the main by the United States Census Bureau and the United States Geological Survey. The first portion of the history is a general *résumé* of the various stages in the development of the industry through the manufacture of common bricks, glazed bricks, terracotta, tiles, and pottery. In the second portion of the work, these stages are discussed State by State.

The author can seldom be charged with diminishing the value of his facts by entangling them in the meshes of hypothesis. Statistics are given showing the yearly value of the products made in the United States, and also imported. Using the word "consumption" with its broadest connotation, it is possible to calculate from the authors' tables the approximate proportion of the total yearly consumption of "pottery" which is actually manufactured in the States. We thus obtain 57 per cent. for 1870, and 68 per cent. for 1907. The influence of the ceramic schools is said to be a "strong factor" (pp. 6–7) in the evolution of the industry. The first of these was started in Ohio in 1894, under the capable hands of Prof. E. Orton; the fifth, in Iowa, in 1907. Quoting from Mr. J. Moses' "One Hundred Years of American Commerce" (p. 53), the authors state that it was not, indeed, until the first real protection by the tariff ever accorded the potters was enacted, as a war measure, that the American maker found himself able to enter the field against the English potter. The influence of imported workmen, on whom there is no tariff, is not indicated, although we find some curious evidence pointing in that direction from Messrs. Ries and Leighton's tables. In 1897, 41 per cent. of the total china clay consumed in the States was mined there, and in 1907, 68 per cent. The remainder was imported. This might be attributed to the dearth of china clay, but the Americans have splendid clays, better, indeed, than our own. The greater probability is that the "secret" recipes of the imported workmen are compounded with raw materials from Cornwall, &c., and a mysterious virtue is supposed to reside in a recipe for an "English" body or glaze. The workmen have not always the courage and skill to adapt imported recipes to local materials. The recipe is thus master of the situation.

J. W. MELLOR.

## *A JOURNEY ACROSS VENEZUELA AND COLOMBIA.*

*The Journal of an Expedition across Venezuela and Colombia*, 1906–7. An Exploration of the Route of Bolivar's Celebrated March of 1819, and of the Battlefields of Boyaca and Carabobo. By Dr. Hiram Bingham. Pp. viii+287. (New Haven, Conn.: Yale Publishing Association; London: T. Fisher Unwin, 1909.) Price 10*s.* net.

THE expulsion of Spanish power from the present State of Colombia was effected by Bolivar, who in the year 1819 conducted an army from near Caracas to Bogotá, across country that had been deemed to be impassable. All the saddle and pack animals, and many of the soldiers, succumbed to the hardships of the march, a distance of about 700 miles, traversed in about seven weeks. Spanish-American historians have compared this feat with the marches of Hannibal and Napoleon. Dr. Bingham, lecturer on Latin-American history at Yale, wanted to form a proper estimate of the actual obstacles that were overcome by the army of liberators, the backbone of which was the foreign legion of British veterans from the campaign of Waterloo. He therefore undertook the spirited and difficult task of following up the route of Bolivar through regions not easily visited and scantily known.

There is a regular overland route from Caracas to Bogotá which leads over the high plateau between the Central and the Eastern Cordilleras. The author and his companion, Dr. Hamilton Rice, however, went, like Bolivar, broadly speaking, parallel with this road, along the foothills of the Eastern Sierras, where they join the vast Llanos, at an average altitude of 600 feet to 700 feet above sea-level. The greater part of this route has been scantily described by but few travellers, and some districts were known locally only.

The travellers left Caracas at the beginning of January, 1906, and crossed the great Llanos with mules, and an ox-cart for the baggage. In time the cart had to be discarded. There were many rivers to cross, tropical forests, and the Llanos. These, never pleasant to traverse, were rendered more than difficult by the rains which set in about the middle of March, and continued with increasing force. The stiffest part of the journey began with the ascent to the plateau, to gain which the Paramo, a pass of 13,000 feet elevation, had to be negotiated.

For reasons only known to themselves, the travellers did not carry a tent. Consequently the diary is full of the troubles of getting accommodation in the wretched villages or occasional so-called towns, in rest houses kept by suspicious Indians or disobliging white men, often without sufficient food. The Western Venezolanos (why are they persistently called Venezuelans in the book?), white, mixed, and brown alike, are apparently not a very prepossessing people, and local officials were, of course, worse. The Colombians seemed to be more amenable, as being less beyond the reach of civilisation.

The whole journey took 115 days, more than twice the time required by Bolivar's army. The book is adorned with numerous photographs of characteristic

scenery and scenes, *e.g.* Yaruro Indians between the Apure and Araura rivers. Although the travellers do not profess to be naturalists, they mention a good many birds and beasts which they came across. There are also some most interesting pictures of Iabiru storks on their nest, and of half-a-dozen Capybaras on the bank of a stream.

The reader will get a very good idea of the kind of country and its inhabitants.

## A STUDY OF CHILD-LIFE.

*Children in Health and Disease. A Study of Child-life.* By Dr. David Forsyth. Pp. xix+362. (London: John Murray, 1909.) Price 10*s.* 6*d.* net.

THIS volume should appeal to a large number of readers, medical and lay, and its publication at the present time is opportune, for it brings a sane and experienced judgment to the assistance of those who in a public or private capacity are striving to solve the problems with which it deals. The vitality of the country depends on the health and training of the children, and while the duty of supervision rests with the physician, success can only be obtained through intelligent cooperation of parents and teachers.

The early chapters deal with the physiology of childhood. The food consumption of the infant, relatively to body weight, is considerably greater than that of the adult, but only one-fifth of the ingesta is used for purposes of growth, while the rest serves to maintain the temperature of the body. In proportion to bulk, the surface area is greater in a small child than in a man, hence increased loss of heat and more need for heat production. In early life appetite waits on surface area, and in the recognition of this fact lies the clue to the proper feeding of children. The amount of food should be determined by the weighing-machine rather than the calendar, and it should contain plenty of carbohydrate, the heat-producing ingredient in diet.

By the end of the second year a child's mind has acquired, in an elementary form, most of its principal faculties, so that its further progress consists in perfecting them rather than in the acquisition of new ones. Habit clusters round the lines of least resistance, and education is an attack on natural indolence. From the medical point of view school-life stands by itself. Opportunities for the transmission of infectious and contagious diseases are greatly increased, and the problem of class-room hygiene offers special difficulties. The evils of the examination system, defective ventilation, bad feeding arrangements, and insufficient hours of sleep exist in many higher-grade schools, as they do in elementary schools. The hygiene and curriculum of both require supervision. Medical inspection of schools is now recognised as a branch of public-health work. It has shown the prevalence of ill-health, much of which is preventable. The author notes with approval the value of invalid and "open-air" schools, and he also discusses the difficult question of the training and care of the mentally deficient.

Not the least interesting section of the book is that which deals with the causes of infant mortality. Most diseases of childhood are preventable, and yet 20 per cent. of children die before their fifth birthday. Infancy must always remain a critical period of life, but it should be relieved of many dangers which now decimate it. The statistical value of death certificates will not be great until they become confidential and cease to be framed so as to meet the susceptibilities of parents. Syphilis is scarcely mentioned in death certificates, although it is recognised as a potent cause of premature birth and death in early childhood.

The value of the volume is enhanced by the index, which is well arranged and adequate.

## OUR BOOK SHELF.

*Lehrbuch der Pharmakognosie.* By Dr. George Karsten and Dr. Friedrich Oltmanns. Second edition. Pp. vi+358. (Jena: Gustav Fischer, 1909.) Price 9 marks.

IN the first edition of this work, published in 1903, Prof. Karsten explained his object to be the provision of a text-book that should treat pharmacognosy from a botanical point of view, and, considered in this light, it must be admitted that his object was successfully attained. But the second edition has more ambitious pretensions; it is intended to present a "clear survey of pharmacognosy and to introduce the young pharmacist to the varied provinces of that science."

The arrangement and treatment of the subject-matter are similar to those that were adopted in the first edition. The classification is on strictly botanical lines. Each drug is separately described, the description including the botanical and geographical sources, the morphology, anatomy, and constituents. In almost all instances the lion's share has fallen to the morphology and anatomy, these usually occupying some three-fourths of the entire description, but occasionally more, as with white hellebore rhizome, where only twenty lines out of six pages are devoted to the other points. This part of the descriptions is excellent, and doubtless many pharmacognosists will frequently refer to the very complete, detailed, and well-illustrated accounts of the morphology and anatomy of the drugs.

This, however, is all that can be said in favour of the work. The constituents of the drugs, for the young pharmacist a most important branch, are dismissed in three or four lines, in which sins of omission and commission are frequent and great. Take, for instance, gentian root and chamomile flowers, in which the bitter principles are entirely forgotten; opium, ipecacuanha, aconite, hydrastis, colchicum, and conium, all of them most important drugs, in which the proportion of the constituents is sadly inaccurate; ergot, liquorice, senna, euphorbium, in which they are not brought up to date. Indian and Turkey opiums are said to be made into balls about the size of the fist, and covered with Rumex fruits, while Persian opium is usually made into sticks! Seldom is any sufficient account given of the diagnostic characters of the genuine drug, of the adulterants, changes on keeping, preservation, preparation for the market, commerce, &c. Such a work fails to give a "clear survey of pharmacognosy," and cannot be recommended as a means of introducing the young pharmacist "to the varied provinces of pharmacognosy." It relegates that science to the position of a subordinate department of botany, and shows once more that the author of a work on

pharmacognosy should be a trained pharmacognosist. As an account of the morphology and anatomy of drugs it might have been successful; as a text-book of pharmacognosy it is a failure.

HENRY G. GREENISH.

*Catalogue of the Lepidoptera Phalaenae in the British Museum.* Vol. viii., Catalogue of the Noctuidæ. By Sir George F. Hampson, Bart. Pp. xiv+583; pls. cxxiii–cxxxvi, and 162 text-figures. (London: British Museum, Natural History, 1909.) Text, price 15*s.*; plates, price 12*s.*

WE have again to congratulate Sir George F. Hampson and the Trustees of the British Museum on the completion of another volume of the great catalogue of moths, which bids fair to surpass even the catalogue of birds in extent and importance. Vol. viii., now before us, is the fifth volume devoted to the Noctuidæ, and the second of the great subfamily Acronyctinæ, which it will require a third volume to complete. Fifteen subfamilies of Noctuidæ were indicated by the author at the commencement of his work; possibly he may find it necessary to increase the number before its completion. The Acronyctinæ, occupying three volumes, is only the fourth subfamily out of the fifteen, but, in the sense in which the author employs it, it is, perhaps, the most extensive of all. The remaining subfamilies, with three or four exceptions, appear likely to be of very much smaller dimensions.

Works of this character are far too costly to be undertaken by private enterprise, and though the price at which they are published by the museum cannot be remunerative, the cost of an extensive work issued in successive volumes soon becomes prohibitive to private students.

Hence we would urge on the librarians of public libraries and museums at home and abroad to secure sets of such publications as those of the British Museum before the volumes become too numerous, and before any of the earlier ones go out of print. Many of the earlier publications of the Museum were issued in comparatively small numbers, and several are now scarce and difficult to obtain. Sometimes early volumes have been exhausted even before the whole series has been completed. This is another reason why public libraries, to which they will always be valuable, should not neglect to add them to their shelves as soon as they appear.

*The Geology of South Africa.* By Dr. F. H. Hatch and Dr. G. S. Corstorphine. Second Edition. Pp. xvi+389. (London: Macmillan and Co., Ltd., 1909.) Price 21*s.* net.

THE general scheme of the book remains the same as in the first edition, but the authors have skilfully rearranged portions of the original subject-matter and have made those additions which the rapid advance of geological investigation in South Africa since 1905 has rendered necessary.

To digest and sift the numerous official and unofficial reports dealing with the geology of South Africa is no easy task, and with respect to the stratigraphy of these regions, the authors have evidently spared no pains to bring the book up to date. They, however, almost entirely ignore the many interesting problems connected with the origin and development of the present physical features, of which striking examples have been illustrated and described in the reports of the surveys of Cape Colony, of the Transvaal, and of Natal, as well as in other publications. This is an obvious omission in a work entitled "The Geology of South Africa."

In dealing with the correlation of the widely scattered formations, the authors speak in a guarded manner, but their suggested correlation of the older formations will not pass unchallenged.

The illustrations, of which many are new, retain a high standard of excellence. The figures illustrating the fossils of the Karroo are the least attractive, and are hardly representative, especially with respect to the well-known and interesting reptilian remains. The general index is far too meagre, and the index of place-names is overburdened by a superfluity of mere page references of more annoyance than assistance to the general reader.

*Handbook for Field Geologists.* By Dr. C. W. Hayes. Pp. ix+159. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 6*s.* 6*d.* net.

THE preface states that this work originated in a handbook printed in 1908 for distribution to members of the United States Geological Survey. Requests for copies of this were so numerous that it was rewritten, omitting those instructions which apply only to members of the Government Geological Survey, and enlarging upon certain features which will be of service to students preparing for work in field geology. In spite of this declaration the book still contains much which is only applicable to members of a Government Survey in the United States, but is, besides, a very practical little handbook, the treatment of the problems connected with the determination of dip, thickness, and depth of beds being perhaps the least satisfactory part. These problems, if properly put, are of great simplicity; but the beginner, trusting to Dr. Hayes, might well conclude that there was some subtle difference between the dip of a fault plane and the dip of a stratum, and that problems which may be tackled in the one case are insoluble in the other.

An attempt has been made to get over the difficulty of making the same work at once a beginner's guide and an expert's *vade mecum* by dividing it into two sections, and of the two the latter seems better done. The schedules of subjects to be noticed in special investigations have their use in refreshing the memory whenever a fresh piece of work is entered on, but the ideal geologist's pocket-book is yet unpublished. Engineers and architects have their little books crammed with information cut up into pieces, each complete in itself, so that temporary lapse of memory on any particular point can be rectified, or reference made to figures which the human brain cannot carry, but which must be accurately known if required at all. Geologists, on the other hand, whether on account of the smallness of their number or their supposed addiction to dilettante methods, are condemned to wade through a mass of matter, with which they are familiar, to obtain the particular piece of information of which they are in search.

*Physiology: a Popular Account of the Functions of the Human Body.* By Dr. Andrew Wilson. Pp. vii+128. (London: Milner and Co., Ltd., n.d.) Price 1*s.* net.

As a contribution to scientific literature this book is negligible; as a popular exposition of the elementary principles of physiology it is untrustworthy. It is no part of a reviewer's duty to enumerate the errors scattered through it; it will be sufficient to take one as a sample. "The red blood corpuscles are also carriers of carbonic acid gas to the lungs . . . and the darker colour of impure or venous blood is explained by the fact that when carbonic acid gas unites with the hæmoglobin a darker hue is produced" (p. 64). A first year's student knows better than this. It would be better to leave the writing of physiological text-books to those who know something of physiology.

W. D. H.

## LETTERS TO THE EDITOR.

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

### Magnetic Storms.

IN supplement to my letter in the last issue of NATURE I may add that if a solar outburst, acting in the way supposed, causes a magnetic storm which lasts eight hours, the effective influence of the whole group of electric streams at the distance of the earth must extend over a breadth of about six million miles; so that if simply conical, with vertex at the sun's centre, the angle of the cone would be four degrees. Projected back to the surface of the sun, this would correspond to what we may call a "spot" about one-thirtieth of the visible disc in diameter; but, inasmuch as the trajectory of the particles in the beam would be slightly curved, the size of the actual solar eruption could be much less.

Until the main outlines of the view advocated are approved by those most competent to judge, it is useless to enter into further details.

I regret to notice a numerical slip—fortunately unimportant, since it affects nothing else—in the top line of my letter on p. 426, where the current equivalent should be expressed, not in hundred thousands, but in hundred millions of amperes—an order of magnitude which is "reasonable" rather than "surprisingly moderate."

October 9. OLIVER LODGE.

### Magnetic Storms and Solar Eruptions.

I HAVE read Sir Oliver Lodge's letter (NATURE, October 7, p. 425) on the above subject with some surprise. The emission theory which he supports, and which he claims to have originated, regards kathode rays from the sun as the electric carriers, and so is presumably the same as has been actively advocated by Prof. Kr. Birkeland for a number of years. He seems, however, to be unaware of the existence of Birkeland's volumes[1] on the subject, and of the numerous numerical calculations therein contained. He also makes no reference to the important mathematical work of Prof. Störmer, which cannot, I think, be disregarded by anyone whose theory postulates the introduction of charged particles from without into the earth's magnetic field. The general idea that magnetic storms are due to some action arising in the sun goes back to at least the time of Broun and Balfour Stewart, and different forms of the emission theory have naturally presented themselves to various minds independently, as Röntgen, kathode, and other rays came successively under our ken. It is when we come to details that real troubles arise. Most people, I take it, have little difficulty in believing in a general way that the changes of declination experienced at a single magnetic observatory, say Kew, during a magnetic storm can be accounted for by a stream of electrons in the magnetic meridian, provided it is possible for the direction and intensity of the stream to be altered at frequent intervals. One doubts this just as little as that the motion of the magnet of the declination magnetograph at Kew on September 25 could be reproduced with the aid of a copper wire, a single battery cell, a commutator, and a resistance box. Those who have seen Störmer's calculations and studied Birkeland's volumes will realise, however, that to be regarded as an advance of knowledge at the present day, a theory must afford an explanation, not merely of what is taking place in a single magnetic element at a single station, but of what is taking place in all three elements at a number of stations. Coming, now, to Sir Oliver Lodge's own calculation, it seems based on an inadequate idea of the phenomena of the late storm, derived from a description of one or two of the more striking changes at Kew as recorded in your columns and those of the *Times*. It is rare for a disturbance to be limited to the declination, *i.e.* for the disturbing force to be wholly perpendicular to the magnetic meridian. The component in the magnetic meridian is, as a matter of fact, usually the larger. A vertical component is also usually present. A magnetic storm does not usually consist of a disturbing force in a fixed or nearly fixed direction, waxing and waning. Each of the three elements usually exhibits values both above and below the normal, and not infrequently there are many excursions on both sides of the mean. This will, I think, be readily recognised by anyone who consults the reproduction of the Stonyhurst curve of September 25 in your columns and of the Kew curves in the *Electrician*. After inspecting these curves it will, I think, be recognised that it is quite out of the question to limit the passage of the imaginary solar jet, as Sir Oliver Lodge does, to the fifteen minutes near the end of the storm, when there occurred the prominent declination oscillation to which he has confined his attention. Even whilst this oscillation took place, it was far from representing the total disturbance. Simultaneously with it, but partly overlapping, as is often the case, there was a very large change in progress in the horizontal force. Those looking at the curves will, I think, agree that if there was a jet such as Sir Oliver Lodge supposes, its time of transit took, not fifteen minutes, but at least nine hours. His estimate of the diameter of the cone thus requires multiplication by 36, with a consequent multiplication of the cross-section, if it were circular, by 1296. Large as this may appear, the jet theory requires it to be often exceeded, as the storm of September 25 was an unusually short one. The average duration of the storms in Mr. Maunder's Greenwich list, from 1882 to 1903, was almost exactly thirty hours, so that the cross-section of the average storm-jet would be naturally fully 14,000 times that given by the calculation in your columns. The really crucial thing is that the magnetic disturbances which occur simultaneously at different stations are inter-related. It is in accounting satisfactorily for these inter-relations that Birkeland, who has given years of thought to the subject, encounters his main difficulties.

In pointing out these facts, I am not expressing any opinion for or against any or all of the emission theories. What I think is really called for at the present moment is a reservation of judgment as to theories, and a more minute study and inter-comparison of the records from different observatories with a mind as unbiased as possible by preconceived ideas. C. CHREE.

October 9.

[1] "Expédition Norvégienne de 1899–1900," and "The Norwegian Aurora Polaris Expedition, 1902–3," vol. i.

### Fireball in Sunshine.

WITH the sun shining in a beautifully clear sky on October 6, at about 9.40 a.m. a large meteorite passed over central England, and was well observed from many widely distant stations. People noticed it in Norfolk, Suffolk, Gloucester, Somerset, and other counties, but the observations, owing to the absence of visible sky marks, are not very definite.

The meteor was brilliant; it had a slow motion, traversing a long path in about four seconds, and it left a luminous trail of short duration. An observer at Bristol says it burst with rocket-like effect at the finish. The meteor had a radiant in the south or south-east sky, but the place is uncertain. At the time of the observation Leo was on the meridian and Virgo and Boötes near.

At Cottesbrook, Northamptonshire, a loud detonation followed the meteor in four minutes, which corresponds to a distance of fifty miles. At East Haddon, Holdenby, and other small towns and villages north-west of Northampton the noise of an explosion was heard, doors creaked, windows rattled, and people ran out of their houses in terror, thinking that an earthquake had occurred. The final disruption of the meteor evidently took place over the region ten or fifteen miles north-west of Northampton, and its direction of flight was from S.S.E., so it must have passed over, or nearly over, London.

Further observations will be exceedingly useful if they are sufficiently exact to be utilised. W. F. DENNING.

### The Mansfield Automatic Water Finder.

CAN any reader of NATURE supply the names of the "leading scientists" who are stated to have "thoroughly investigated" this instrument "and vouch for the successful application of the invention"?

As stated by the makers, "the principle on which the instrument works is the measuring of the strength of the electrical currents which are constantly flowing between earth and atmosphere, and which are always strongest in the vicinity of subterranean water courses." It would be interesting to know whether there is any scientific basis for this statement.

The writer has applied to the makers of the instrument for particulars relating to it, but beyond sending him a circular embodying the above quotations, he has been unable to obtain from them much information.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., October 7.

## MOVEMENTS OF THE EARTH'S SURFACE.

IN the *Revue scientifique* of August 28 is an interesting address delivered by M. Ch. Lallemand to the Association française pour l'Avancement des Sciences. The address deals with two subjects:—(1)

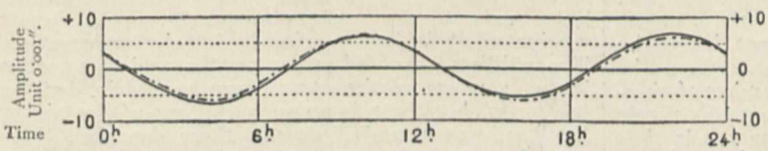



FIG. 1.—Semi-diurnal oscillation of a pendulum under the action of the moon.

——— Observed wave. — · — · — Calculated wave reduced in amplitude.

Tides in the solid earth; (2) gradual changes of level in large tracts of the earth's surface.

The first subject is introduced by a short historical account of the attempts made in the past thirty years to discover alterations in the position of the vertical relative to the earth's surface accompanying the changes of direction of the sun and moon. This is followed by a detailed account of the recent work of Dr. Hecker, of Berlin. An illustration of his apparatus is given, and an interesting account of the manner in which, by a mechanical and optical device, a horizontal pendulum, 0·25 m. in length, is made to produce effects such as could only be produced directly by a vertical pendulum of length equal to the height of Mont Blanc.

Dr. Hecker's apparatus was placed in a chamber, which was situated at a depth of 25 m. below the surface of the earth, and kept at constant temperature and humidity. The motions of the pendulum, greatly magnified, were registered continuously on a revolving drum. Roughly speaking, they amounted to a daily oscillation of the vertical of about 0·02″ north and south. The greater part of this oscillation was thermal in origin, being caused by the heating of the upper layers of the earth's surface by the sun's rays. It was possible to remove this term, and there was left as a residual effect a semi-diurnal oscillation, which could be traced to the varying attraction of the sun. More important, because it was more free from thermal disturbance and greater in magnitude, was the semi-diurnal oscillation of the pendulum, which Dr. Hecker found corresponding to half a lunar day. The close agreement between this observed oscillation and a theoretical curve for the deviation is shown in Fig. 1.

Whereas the phase and direction of the changes in the vertical agree closely with theory, the amplitude of the observed change is much less than that which theory indicates. Or, rather, we should say that the amplitude is about 2/3 of that which would be observed if the earth were perfectly rigid. The difference between this factor 2/3 and unity is a measure of the extent to which the earth's surface yields to the tidal force of the moon, and thus masks the deviation of the pendulum. It is interesting to note that in 1884 Sir George Darwin, from analysis of tidal records, found this factor to be 0·676, also that his and Lord Kelvin's earlier estimate of the rigidity of the earth accord closely with that now determined by Dr. Hecker, namely, 5/6 of the rigidity of steel. The difference between observation and theory is shown in Fig. 2.

One interesting fact is illustrated in Fig. 2. The reduction of amplitude from one curve to the other is different in different azimuths. Dr. Hecker has discussed this point, and shown it is in no way to be accounted for as an indirect effect of accompanying changes in the sea-level or the atmosphere. Whether it is due to local surface conditions at Potsdam, or whether it bears some relation to large structural deformations of the earth, these are questions which further research will alone elucidate.

The second question discussed by M. Lallemand is the examination of permanent or gradual deformations of the earth's crust. A short account of changes, which have been shown to have been caused by recent earthquakes, is followed by a discussion of attempts made in France to ascertain gradual changes of level. Accurate work of recent date has discredited Bourdaloue's result that the sea-level at Brest and Marseilles differs by a metre, that result being ascribed to systematic errors in the observations. The difficulty of ascertaining permanent changes of level is increased by secular alterations in the mean sea-level at the base of a level-line. Added to this are the errors of the actual work of levelling. M. Lallemand's estimate of the error that would probably be introduced in ascertaining the height of a hill-top 2000 m. above sea-level, at a distance of 600 kilom. from the sea-shore, is

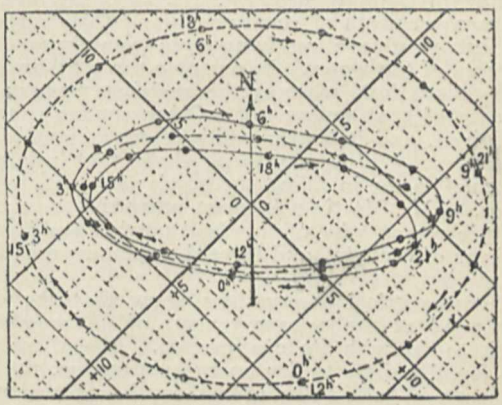



FIG. 2.—Daily apparent motion of the pendulum due to the action of the moon.

——— Observed oscillation.
· — · — Observed semi-diurnal oscillation.
– – – – Semi-diurnal oscillation calculated for a rigid earth.

12 cm. to 17 cm. even when the levelling is done by the most accurate methods at present available. In view of the slowness with which changes of level take place, an interval of at least thirty years ought to elapse between successive levellings undertaken to show changes of level.

In time we may hope to ascertain by repeated geodetical researches in what way countries, or even whole continents, are rising and sinking. In such work the geodesists will have the fullest support of all

men of science. In particular they may expect sympathy from the astronomical world, which will soon be faced by an allied problem. The question must, before many years, come up for decision as to when a repetition of the chart of the heavens, which is slowly nearing completion, will be justified by the conclusions to be drawn from it.

## SCIENTIFIC STUDIES OF DEW-PONDS.

AN endeavour to solve the so-called mystery of the dew-pond has recently been made by Mr. E. A. Martin, and the results of some of his observations are shown in a paper which appears in the *Geographical Journal* for August. The paper was read before the Research Department of the Royal Geographical Society on April 22. Attempts were made by direct experiment to ascertain how the replenishment of such ponds takes place. During the autumn of 1908, Mr. Martin spent many nights and days on the Clayton downs, in Sussex, and thus was on the spot during the hours when, according to theory, the ponds should be receiving dew. The result of a large number of thermometrical observations went to show that very rarely does the temperature of the water of the ponds sink below that of the air above it, or below dew-point.

The term "dew" is widely used to mean any kind of condensation which does not fall as rain, hence "dew-ponds," "mist-ponds," and "cloud-ponds" are terms which are used for one and the same kind of pond. On the Sussex Downs no overhanging tree to condense moisture out of the air is found, as a rule. The bare down is all around, whilst in the water there is, as a rule, pond-weed, or reeds, sometimes projecting above the surface of the water. Where this happens, dew is undoubtedly precipitated on the reeds, and this helps to replenish the pond. But many ponds have no projecting vegetation, and yet do not suffer greatly in times of drought. It is pointed out that the measurements of some ponds and their surrounding basins give a receiving area sometimes double the area of the water. In one case the pond-area was 4120 square feet, whereas the shelving margin gave an area of 5795 square feet. Other similar examples are given, and it is this width of margin which has caused many observers to conclude that rainfall is the chief factor in filling the ponds; but not the only factor, as Mr. Martin points out, otherwise there would be little reason why the lowland ponds should dry up in times of drought, and leave the upland ponds fairly full.

Thermometrical observations show that the depth of a pond at the commencement of a drought has much to do with its continuance. A shallow pond was found rapidly to dry up by evaporation, the high temperature gained during the day being well maintained during the night. On the other hand, a deep pond will but slowly be heated, and may well be saved excessive evaporation until a break in the weather comes, and normal conditions again prevail. One pond which was but a foot deep was found so late as 8.20 p.m. in July to show no differences of temperature at 1 inch, 6 inches, and 9 inches, the thermometer registering 67·5° F., whilst that on the bank showed a reduction to 58·5° F. The water lost heat but slowly, and no doubt evaporation went on well into the night. Three weeks later it was dry. Another pond, 3 feet deep, showed, at 6 p.m., 76° F. at 1 inch, 74° F. at 6 inches, and 71° F. at 9 inches, and two hours later the 1-inch temperature had been reduced to 70¾° F., whilst the 6-inch and 9-inch temperatures were uniform at 71° F., the surface temperature showing a considerable loss. There was in this pond a large quantity of rushes, and the loss by evaporation was almost compensated for by the deposition of dew upon their exposed surfaces. This pond did not dry up.

Attention was given to the alleged chilling of the water below dew-point, but it was found that although such a circumstance rarely happened, it sometimes was seen that the temperature of the air resting on the water was below dew-point. Further observations in this direction are to be made. Numerous experiments were made to determine whether straw, wood, and woodwool were likely to effect a chilling of the water of a pond resting on a foundation of these materials, and the evidence pointed to these acting in the desired direction. A series of experiments showed that both "downward" and "upward" dew would be found on different nights according to certain atmospheric conditions, and it is pointed out that if a pond were to depend on the latter only for its replenishment, it would simply receive what it had previously lost by evaporation. The chilling effect of grass on the moisture-sodden lowest stratum of the atmosphere results in dew on the grass, but there is no such chilling of the air by the pond-water, and if dew is there deposited there must be some other cause at work.

It is found that out of seven localities quoted where straw has been used in the foundations of dew-ponds, in no case has it been used with the idea of inducing dew-deposition in the pond. Sections of dew-ponds are given in the paper, constructed according to various authorities. The most remarkable case seems to be that in Wiltshire, where foundations are laid in the form of six layers of straw and clay alternately, but here again the reason given is that the straw prevents the clay from cracking. Incidentally, Mr. Martin refers to the danger to clay-puddled ponds from the small red-worm, swarms of which were met with in some ponds. An estimate of dew-fall on grass was made, giving 0·77376 inch per annum.

So far as rainfall is concerned, it was found that in thirty-two days the amount measured on the downland was 2·57 inches, but a gauge placed in a hollow dug for an experimental pond measured 3·51 inches. This seems to show that a pond-depression on the downs would draw into it, by setting up currents and eddies of the wind, a greater quantity of rainfall. By experimenting with a gauge in the rim of which had been placed some straw and grass, in imitation of conditions which obtain in some ponds, it was found that when 0·37 inch was measured on the down, 0·54 inch was measured in the gauge; when the former showed 0·32 inch, the latter showed 0·69; when the former showed 0·46 inch, the latter showed 0·80 inch. The gauge with the straw and grass was placed in the hollow.

In order to determine whether the chemical composition of pond-waters would give any clue to their origin, a number of analyses of such waters was made at the South-Western Polytechnic, and the results are given in the paper. These seem to show that there is too much sodium chloride contained in the ponds to have come from rain-water, and in normal conditions dew certainly contains no common salt. The sea-mists may reasonably be held to be responsible for the saline qualities of the waters.

So far as the antiquity of the name and the idea of the dew-pond is concerned, Mr. Martin seems to think that puddling by cattle-trampling by accident may have caused artificial ponds first to have been made, and although proof must be lacking, it is possible that

some may be of very ancient date. Wells are so rare in ancient camps on the downs that ponds were probably the chief source of water supply. Why straw was first used, and how it was first used, are likely to remain unanswered satisfactorily. A description is given of a small experimental pond which the author made. The foundations were composed of wood-wool resting on a chalk base, followed by straw and wooden planks, with puddled clay thereon. Further investigations are promised, and no doubt the success or otherwise of the pond will form the subject of a future paper.

In the discussion which followed the reading of the paper, Dr. H. R. Mill claimed that rain is the principal factor in filling the downland ponds, and suggested that the reason why the lowland ponds the more quickly dry up may be that they are not so carefully made watertight as those on the higher ground.

## *ARTIFICIAL PARTHENOGENESIS.*[1]

THE development of biology into an experimental science is nowhere better illustrated than in the important researches on artificial parthenogenesis which we owe largely to Jacques Loeb, and biologists will welcome heartily the little book in which this distinguished author gives an account of the subject. Prof. Loeb informs us that the object of his investigations was to transfer the problem of the fertilisation (Entwicklungserregung) of the animal egg from the domain of morphology to that of physical chemistry. He recalls the fact that it is only about sixty years since it was first firmly established that the animal egg—with the exception of a few cases—can only develop into an embryo after fertilisation by the entrance of a spermatozoon. Various interpretations have been placed upon this process. O. Hertwig maintained that the essential feature of fertilisation was the union of the male and female pronuclei in the egg-cell, and the observation of this union was undoubtedly of the greatest importance, especially from the point of view of the theory of heredity, but it gave us no real insight into the nature of the stimulus which evokes as its response the segmentation of the egg. Boveri, indeed, maintained that the union of the two pronuclei had nothing to do with providing this stimulus, and was able to show that an enucleated egg may develop after fertilisation by a spermatozoon. According to Boveri the centrosome is the organ of cell-division, and the unfertilised egg cannot develop because the centrosome is wanting. A new centrosome is introduced by the spermatozoon, and then cell-division or segmentation commences.

Loeb, however, maintains that the development of the egg is a chemical process, depending mainly on oxidation, in which there takes place a synthesis of nuclear material from constituents of the cytoplasm. He accordingly regards the Boverian hypothesis, in which a purely mechanical *rôle* is assigned to the centrosome, as inadequate to explain the nature of fertilisation. His earliest experiments consisted in treating the eggs of a sea-urchin with sea-water, the alkalinity of which had been increased by the addition of soda-lye. In such water the eggs segmented once or twice, but did not develop further. On the other hand it was found possible to cause the unfertilised eggs to develop into larvæ by placing them for a couple of hours in hypertonic sea-water—sea-water, that is, the osmotic pressure of which had been raised about 60 per cent. by the addition of some kind of salt or sugar. This apparently purely osmotic stimulation of the egg was subsequently found to comprise two factors, viz., the loss of water by the egg, and the concentration of the hydroxyl-ions of the hypertonic solution. It was also found that the hypertonic solution can only stimulate the egg to development if it contains free oxygen in sufficient quantity.

The author next succeeded in producing larvæ from unfertilised eggs of Chætopterus by means of potash and acids without raising the osmotic pressure of the sea-water.

It has long been known that the eggs of many animals, immediately after the entrance of the spermatozoon, form a "fertilisation membrane" on the surface. We used to be told that this membrane served to prevent the entrance of additional spermatozoa. Loeb attributes to it a much deeper significance. He finds that in the case of osmotically "fertilised" eggs no membrane-formation takes place, but a short treatment with a monobasic fatty acid causes the formation of a typical "fertilisation-membrane" in all the eggs of Strongylocentrotus. If such eggs are then placed for a short time in hypertonic sea-water they all develop into larvæ. The artificial membrane-formation by itself, however, in this case only causes the eggs to commence their development without being able to continue it.

The membrane-formation is regarded as the most important factor in fertilisation. It has also, however, a deleterious effect, a tendency to cytolysis, which requires to be counteracted by treatment with a hypertonic solution, or in some other way. In some species the artificial membrane-formation alone is sufficient to bring about the development of the eggs to normal larvæ, the injurious cytolytic effects being less marked than in the sea-urchin. That it is the membrane-formation and not any other action of the fatty acid which brings about the development of the egg is evident from the fact that membranes produced in any other way have the same effect.

The author attributes a like importance to membrane-formation as the essential factor in the normal fertilisation of the egg by the spermatozoon, and proceeds to inquire what substances and agencies determine such formation. Membrane-formation may be regarded as a stage in the cytolysis of the egg, and all cytolytic agents will cause membrane-formation. Clearly the cytolysis must be arrested in some way after the membrane has been formed, otherwise it will lead to the destruction of the egg. Loeb maintains that in the natural fertilisation of the egg the formation of the fertilisation membrane is brought about by a "lysin," carried by the spermatozoon, which also brings with it a second substance which serves to counteract the evil effects of membrane-formation.

Such is the essence of the "Lysin Theory" of fertilisation. As an attempt to interpret biological phenomena in terms of chemistry and physics, it is of the greatest interest, though the point of view from which its author regards the phenomena of fertilisation may not be the one which appeals most strongly to students of biology.

We do not doubt that a new edition of this extremely interesting work will shortly be called for, and we hope that it may be found possible to publish it simultaneously in German and English. Not the least valuable feature of the book is, to our mind, the introduction of twenty-one pages, in which a concise *résumé* of the entire subject is given.

[1] "Die chemische Entwicklungserregung des tierischen Eies (Künstliche Parthenogenese)." By Jacques Loeb. (Berlin: Julius Springer, 1909). Price 9 marks.

## NOTES.

A MEETING to further the interests of the forthcoming expedition, under Captain Scott, to the South Polar regions, was held at the Mansion House on Tuesday last, the Lord Mayor presiding. Captain Scott laid the plans and objects of the expedition before the meeting, and stated that 40,000*l.* was required for the estimated cost of the first year's work. He further said that if that sum was contributed by this country he hoped that, with the cooperation of the over-seas dominions, they might raise a sum sufficient to carry on the work until it was finished, that was to say, if necessary, for a second and possibly a third season. He would prefer a request for support to the Government of the Commonwealth of Australia, because the scientific work of an expedition of that kind —its meteorological and magnetic observations—was possibly of greater use to the countries which lay adjacent to the region of research than it was to the homeland. A resolution in support of the expedition was passed.

ACCORDING to a Reuter telegram from Washington, the National Geographic Society has passed a resolution requesting Dr. Ira Remsen, president of the U.S. National Academy of Sciences, to appoint a commission to examine the records and observations of Dr. Cook and Commander Peary. This action is based on a proposal made by the Peary Arctic Club.

AT a meeting of the executive committee of the Zeppelin Polar Expedition, held at Friedrichshaven last week, it was decided that a preliminary expedition should be sent next summer to Spitsbergen in order to investigate the polar ice and determine the conditions affecting the management of airships in those regions. The committee laid great stress upon the importance of promoting the development of Zeppelin airships for long journeys, especially over the sea, for the purpose of scientific investigation. Plans are to be drawn up immediately for the construction of a suitable airship, which is to be ready at the beginning of 1911.

IT is stated by a *Times* correspondent that Mr. Evelyn Baldwin, the leader of the Baldwin-Ziegler expedition of 1901–2, announces his intention to make an attempt to reach the North Pole by drifting with the ice eastward on a parallel course to that taken by the *Fram*. He calculates that the voyage will last four years.

LIEUT. SHACKLETON delivered a lecture before the Danish Geographical Society on Saturday last on the work of his late expedition, and received from the president the gold medal of the society. He also had conferred upon him, by the King, the Commandership of the Dannebrog Order of the Second Class. It is the intention of the explorer to present a small collection of specimens of Antarctic rocks to each of the principal geological museums.

A SEVERE shock of earthquake was experienced in the island of Shetland at about two o'clock on Saturday morning last. The shock was accompanied by a dull rumbling sound, which many fishermen mistook for the sudden outbreak of a hurricane.

ACCORDING to a Reuter message, a severe earthquake shock was experienced at Reggio di Calabria in the morning of October 7.

A STORM of unusual violence broke over Havana and the coast of Florida on Monday last. The damage to property at Key West is estimated at 400,000*l.* At Havana five persons were killed and many injured.

WE note with regret the death, on Saturday last, of Dr. Hugh Blackburn, emeritus professor of mathematics at the University of Glasgow. Prof. Blackburn was born on July 2, 1823, and filled the chair of mathematics in the University from 1849 until 1879, when he was succeeded by Prof. Jack.

MR. RICHARD BANNISTER, whose death occurred at his residence in South Kensington on September 27, had held the position of deputy principal chemist in the Government laboratory for about twenty-five years. He attended the Royal College of Chemistry in 1862–3, obtaining full marks at the final examination of the students, and was attached to the small chemical staff then at Somerset House. Eleven years later he was promoted to the post of deputy principal, and continued to hold this office until his retirement from the public service in 1898. On such analytical matters as the detection of adulterations in tobacco or of methyl alcohol in spirituous liquors, Mr. Bannister in the earlier stages of his career was often required to give expert testimony. Later, however, in accordance with what his duties demanded, it was chiefly as an administrator and a shrewd man of business that his capabilities were shown. He gave evidence before several Royal Commissions, notably upon the questions of the materials used in brewing beer and the adulteration of food products. His knowledge, judgment, and sound common sense were also recognised outside strictly official circles. He was a Cantor lecturer on certain food-stuffs, such as tea and coffee, the lectures containing much useful technical information of a kind not easily found at that time in text-books. He acted as juror at the Paris and Chicago exhibitions, where his combined chemical and business experience—for he was a director of the Civil Service Stores, as well as an analytical chemist—was no doubt of exceptional value. Mr. Bannister, who was in his seventy-fifth year, was a member of the council of the Institute of Chemistry.

MR. JAMES BRITTEN has just retired from the botanical department of the British Museum after a period of service of thirty-eight years. Previously to joining the staff of the British Museum he was for two years an assistant in the Kew Herbarium, and has therefore completed forty years in the service of the State. Mr. Britten has recently been engaged in the preparation of a catalogue of the Sloane Herbarium, which will shortly be published by the trustees. The collections of Sir Hans Sloane, it will be remembered, were the foundation of the British Museum, and his herbarium contains some of the earliest botanical collections from many parts of the world, and is of great importance in connection with the systematic works of Linnæus and other botanists of the eighteenth and early nineteenth centuries.

ACCORDING to a *Times* correspondent, a further fossil human skeleton has just been discovered in the department of the Dordogne at Ferrassie, 5 kilometres from Bugue, in a layer belonging to the lower middle post-Tertiary period.

A CORRESPONDENT of the *Globe* states that the remains of a lake-dwelling (reputed to be 4000 years old) have just been discovered by Dr. Otto Froodis while excavating the hilly region near Lake Vettern, in Sweden. Weapons and primitive household utensils were found in stone, flint, bone, and horn.

THE demonstrations in connection with the museum of the Royal College of Surgeons of England, which were inaugurated last year, are to be continued by Profs. A.

Keith and S. G. Shattock. This year's course is to begin to-morrow. It will be open to all practitioners and medical students on presentation of their cards.

THE first monthly general meeting of the new session of the Institution of Mechanical Engineers will be held to-morrow, when a paper will be read by Prof. W. E. Dalby entitled "Heat Transmission." It will be remembered that in 1906 the members of the institution decided, by vote, that the subject of heat transmission was suitable for further research, and Prof. Dalby has therefore, at the request of the council, collated in an appendix to his paper information already published relating to the transfer of heat across metallic surfaces in contact with water and with gases.

THE syllabus of the first half of the 137th session of the Medical Society of London has reached us, from which we learn that on October 25 a paper is to be read by Dr. F. W. Hewitt on the need for legislation in regard to anæsthetics, and the lines upon which it should take place. Subsequent papers will be read by Prof. Arthur Keith and Dr. James MacKenzie. The Lettsomian lectures will be delivered on February 7 and 21 and March 7 by Dr. J. S. Risien Russell, on the cerebellum and its affections.

ACCORDING to the *Lancet*, a new edition of the catalogue of the pathological section of the Museum of the Royal College of Surgeons of England is to be prepared by Prof. S. G. Shattock, with the assistance of Mr. Alban Doran; a new edition of the catalogue of the Entozoa, by Dr. R. T. Leiper, is also in preparation.

NOTICE is given of the holding, in June and July, 1910, of an International Agricultural Exhibition at Buenos Aires. Communications respecting the exhibition should be addressed to the secretary, 316 Florida, Buenos Aires.

THE inaugural meeting of the China Philosophical Society was held at Tientsin on September 18, under the presidency of the president of the Pei Yang University (Mr. Wang Shoh Lian), who, in the course of his address, pointed out the importance of the existence of such a society in the present stage of China's development, when western learning is being spread over the Empire. The possibilities before the society are unlimited, as all branches of science and art present practically untouched ground, and it can do much to build up the new learning, to foster and organise research, to unite Chinese and foreign students in a common cause, and help these to understand each other better; to assist in the introduction of foreign methods and in the adaptation of these, and yet to protect and retain those older methods which are threatened with extinction. After the delivery of the address referred to, papers were read by Dr. G. Purves Smith, on agricultural possibilities of North China, and Dr. Wu Lien Teh, on a striking example of scientific farming in Chihli.

WE learn from the *Times* of October 11 that the shipments of salmon ova to New Zealand in the early part of this year have, so far, proved highly successful. Of the first consignment of some half-million eggs from Scotland and Ireland, only about 5·6 per cent. died on the voyage out. The second consignment consisted partly of English and partly of German eggs; the latter had to be re-packed in London, and about 7·8 per cent. of them perished on the voyage to New Zealand, while of the former only about 1·7 per cent. failed to reach their destination in safety. On their arrival in New Zealand the eggs were immediately sent to the hatcheries, where they commenced hatching out within a few hours of their arrival. There is clearly no difficulty about transporting salmon eggs to New Zealand in good condition. The difficulty is to rear the young fish after hatching. Hitherto all attempts to do this have failed in New Zealand, and we shall be much interested to hear what happens in the present instance. If they can once get established, there seems no reason why the salmon should not thrive in New Zealand as well as the trout, the acclimatisation of which has long since been successfully accomplished.

THE exploration of the fauna and flora of the waters of Lake Tanganyika has been carried out with important results during the last ten years owing to the efforts of Sir Ray Lankester. He obtained funds from the Government grant committee of the Royal Society, in the first instance, in 1895, which were employed in sending Mr. J. E. S. Moore on a preliminary expedition. The results obtained were so promising that in 1899 Sir Ray Lankester collected from those interested in the great lake and in African natural history a special fund amounting to more than 4700*l.* for further exploration, and obtained the assistance of a committee of naturalists in its administration. Mr. Moore was sent on a second expedition, well equipped and furnished with funds for the hiring of a steamer which had been placed on the lake by some enterprising pioneers. On Mr. Moore's return a third expedition was entrusted to Dr. W. A. Cunnington, of Christ's College, Cambridge, who has given special attention to the algæ and the smaller invertebrates of the lake. The money collected by Sir Ray Lankester has now been all spent, and an account rendered to the subscribers, together with a list (a copy of which we have received) of the numerous important publications on the fauna and flora of Lake Tanganyika, written by various experts who have undertaken the study of the collections brought home by Mr. Moore and by Dr. Cunnington. The most extensive results are those published by Mr. Boulenger, in five separate memoirs, on the fishes, which include a vast number of new species and genera; Mr. Moore's publications on the new gastropod molluscs and the anatomy of many of them, and on the reproduction of the fresh-water jelly-fish, Limnocnida; papers on the Crustacea, by Messrs. Cunnington, Calman, G. O. Sars, and Stebbing, and on the botanical collections by Dr. Rendle and Prof. G. S. West. All the collections have been placed in the Natural History Museum, although the trustees did not in any way contribute to the expenses of the expedition, which was a purely individual enterprise carried out by Sir Ray Lankester when director of the natural-history departments. It now remains for Dr. Cunnington to give a clear and concise illustrated account of the natural history of Lake Tanganyika so as to embody the results of all this recent investigation in a readable form, with indication to the reader as to where he may find the various scattered memoirs in which the detailed descriptions are published.

PART iii. (June) of the Ceylon Marine Biological Reports is devoted to an account, by Messrs. T. Southwell and J. C. Kerkham, of an inspection of certain pearl-banks situated between Dutch Bay Point and Negombo, which are at present under the control of the Ceylon Government. The inquiry was conducted by the Ceylon Company of Pearl Fisheries, Ltd., which at present holds the main fisheries in Ceylon; and the chief results seem to be that these southern banks are exposed to the continuous influence of adverse surface-currents, and that the nature of the sea-bed is less well adapted for oyster-culture than is the case in the leased beds. Further, the close proximity

of the southern banks to the "overfalls" renders them unsafe as oyster-beds, although the actual *modus operandi* by which this is brought about is not at present understood.

IN a note communicated to vol. xxxiii., No. 3, of the *Tropical Agriculturist*, Mr. E. E. Green states that an attempt is to be made to check the ravages on tea-plants in Ceylon of the beetle known as the "shot-hole borer" by introducing a predaceous beetle (*Clerus formicarius*), which is already well known as an enemy of pine-boring Scolytidæ. Mr. Green decided to try this beetle as an exterminator on account of the good reports of its value as a pest-ridder received from the United States. The experiment can, however, only be of a tentative nature, as the Clerus is an inhabitant of the temperate zone, and it remains to be seen whether it will thrive in the tropics. In a second note the Government entomologist states that in the Ambawella district of Ceylon camphor-plants are attacked by a scolytid allied to the shot-hole borer.

SEVERAL interesting additions to the British insect-fauna are recorded in the October number of the *Entomologists' Monthly Magazine*. Many years ago, it appears that Dr. David Sharp received from Chobham a water-beetle which he was unable to identify; this year he took a second example at Brockenhurst, and he finds both to belong to the continental *Laccobius scutellaris*. In the next article Mr. J. Edwards describes a new beetle from Horning, under the name of *Dryops anglicus*; later on, Mr. E. R. Speyer records the occurrence in Sussex of a number of specimens of the continental dragon-fly *Somatochlora metallica*, a species already known from Scotland, but not hitherto definitely identified in England. Finally, Mr. K. J. Morton mentions the occurrence in the west of Ireland of the trichopterid *Limnophilus fuscinervis*, which is quite new to the fauna of the British Isles.

C. DAWYDOFF contributes to the *Zeitschrift für wissenschaftliche Zoologie* (Bd. 93, Heft 2) a very elaborate memoir on the process of regeneration in the Enteropneusta. He considers that this group of animals, about which so much has been written recently from the morphological and phylogenetic points of view, affords an uncommonly convincing example of the untenability of Weismann's view that the power of regeneration is the result of natural selection. He states that when dredging for Ptychodera only the anterior portion of the body is usually obtained, the hinder end being commonly torn away, and concludes that under normal conditions the animal may lose its hinder end but hardly ever loses its head. He thinks that, according to Weismann's views, the animal should accordingly be able to regenerate the hinder end, but not the head end, while his own experiments show exactly the contrary to be the case, the anterior extremity being very readily regenerated after amputation, but not the posterior. The author's argument in this respect does not appear to us to be very convincing. The facts as stated suggest the possibility that anterior ends are cut off and collected by the dredge because they protrude, while the posterior ends remain buried, and that for the same reason the head ends are likely to be bitten off by fishes. If this be so, the fact that the anterior ends and not the posterior are regenerated fits in exactly with Weismann's views. We need to know something definite about the habits of the living animal before coming to a conclusion on this question. It will interest morphologists to know that Dawydoff finds in the mode of regeneration of the proboscis pores evidence in favour of Schimkewitsch's view that these organs are homologous with the "metanephridia" of annelids, consisting each of a mesodermal funnel and an ectodermal canal, the latter of which he regards as of more recent origin than the former.

DR. W. F. PURCELL contributes to the September number of the *Quarterly Journal of Microscopical Science* (vol. liv., part i.) a very interesting memoir on the development and origin of the respiratory organs in Araneæ. He finds that the first "leaves" of the "lung-books" in spiders appear on the free posterior side of the provisional abdominal appendages, quite outside of the pulmonary invagination, and deduces from this fact that the lung-books are derived from gill-books similar to those of Limulus. The tracheal system is supposed to have a two-fold origin, the pair of lateral tracheæ of dipneumonous spiders having been derived from the second pair of lung-books of tetrapneumonous forms, while the medial trunks of the tracheæ are equivalent in their entirety to metamorphosed entapophyses, *i.e.* to the invaginated ectodermal areas, lined by cuticle, which serve for the attachment of the ventral longitudinal muscles. Dr. Purcell's observations and conclusions should be of great value in settling the much-discussed question of the classification of the Arthropoda—if it ever is settled. The same number contains a further instalment of Mr. Goodrich's work on nephridia, dealing with these organs in Dinophilus and in the larvæ of Polygordius, Echiurus, and Phoronis, and some further notes on a trypanosome found in the alimentary tract of *Pontobdella muricata*, by Miss Muriel Robertson.

AMONG the shikar and natural-history notes contributed to the *Indian Forester* (August) is a note on the Burma mole rat, which, according to the writer, is a serious depredator of Para rubber trees, especially in young plantations, and is also reported to attack seedlings of teak, mango and jack trees. The animal, which is not definitely identified, but may be *Nesocia hardwickei*, is apparently confined to Burma and western Siam.

AN important collation of the genus Cereus and its allies in North America, based upon observations in the field in Mexico and elsewhere, also of living material in the greenhouse in addition to herbarium species, is presented by Prof. N. L. Britton and Dr. J. N. Rose in the final part (No. 10) of the twelfth volume of Contributions from the United States National Herbarium. Following to a considerable extent the revision by Mr. A. Berger, except that they raise several of his subgenera to generic rank, the authors distinguish twenty-three genera, of which Cephalocereus, Echinocereus, and Lemaireocereus are the chief. The plant originally named *Cereus greggii*, that has a curious turnip-shaped root, is made the type of one of the new genera, Peniocereus. The same part contains descriptions of five new Mexican Crassulaceæ communicated by Mr. J. N. Rose, and a supplement to the monograph of North American Umbelliferæ by Drs. J. M. Coulter and J. N. Rose.

As might be expected, the officials of the Department of Agriculture in the Federated Malay States have been called upon for advice regarding pests of Para rubber trees. Mr. H. C. Pratt has collected further information on the ravages of the ants identified by him as *Termes gestroi*, which is published in Bulletin No. 3, together with methods of treatment. No insecticides can be recommended, but eradication of old tree stumps and carefully devised fumigation with arsenic and sulphur of the burrows leading to hollow stems have proved efficacious. Mr. W. J. Gallagher discusses in Bulletins Nos. 2 and 6

the root disease caused by *Fomes semitostus*, and a branch and stem disease which has not yet been traced to a specific fungus. The Fomes spreads from the old stumps of jungle trees, so that eradication of these is the only remedy, while excision of infected parts and treatment with Bordeaux mixture have proved effectual against the less dangerous stem disease.

A VARIED selection of microscopic accessories, apparatus for bacteriological and hæmatological investigation, and instruments for collecting natural-history specimens, is kept by Messrs. H. F. Angus and Co., 83 Wigmore Street, who have recently issued a well-illustrated catalogue of this part of their stock. The firm acts as agent for Messrs. Swift, Leitz and Zeiss, also for Dr. G. Grübler, of Leipzig. Another feature of the catalogue is the list of mounted specimens for the microscope, physiological, pathological, and botanical.

THE Francis Galton Eugenics Laboratory has published a lecture by its research scholar, Miss Ethel M. Elderton, entitled "The Relative Strength of Nurture and Nature," which was recently delivered in a course of lectures on national eugenics at the laboratory. By the method of correlation used by the lecturer and her colleagues, she claims to establish the fact that "overcrowding, bad economic conditions, bad physical and moral conditions of the parents, have practically no effect on the intelligence, eyesight, glands and hearing of the children." The results, indeed, show that the children of drunken parents are somewhat healthier and more intelligent than those of sober parents, and generally that the influence of environment is almost negligible compared with that of heredity. As the author admits, some of "these results are certainly startling and rather upset one's preconceived ideas."

IN a work entitled "Die Härte der festen Körper und ihre physikalisch-chemische Bedeutung" (Dresden: Theodor Steinkopff) Dr. Viktor Pöschl makes a valuable contribution to the study of an important physical character of solid substances, which has as yet scarcely received adequate attention from crystallographers and others interested in such matters. He describes a new form of sclerometer recently devised by him; in it the section under test is placed on a carriage and drawn under a diamond point, which may be lightly loaded, and the width of the resulting scratch is measured by means of a high-powered microscope. He gives the results of a series of experiments made upon various minerals and metals. It is interesting to note that the apparently wider scratch made perpendicular to the trace of the cleavage plane is due to incipient cleavage cracks, and that the direction parallel to the trace is really the one of least hardness. Dr. Pöschl discusses with considerable acumen the connection between hardness and solubility, chemical composition, crystal form, and density.

PROF. ECKERT publishes a new "isochronic" chart of the world in the September number of *Petermann's Mitteilungen*. The first part of an article on the construction of such maps, dealing with the history of their development and with modern methods of arranging and reducing the *data* upon which they are based, accompanies the chart.

THE October number of *Travel and Exploration* contains the first part of a paper, by Dr. M. A. Stein, on his journey through the Taklamakan Desert, entitled "Across the 'Sea of Sand.'" The paper gives a graphic account of the incidents of the journey, and is illustrated by excellent photographs.

MR. ELLSWORTH HUNTINGDON contributes an article on the Russo-Afghan frontier region to the September number of the *National Geographic Magazine*. The paper forms the first part of an account of the "Afghan Borderland," based chiefly on journeys made by the author in recent years. Speaking of eastern Persia, Mr. Huntingdon remarks that "the inhabitants stagnate and play no part in the present history of the country except as pawns to be harried by the Afghans, cowed by the Russians, or cajoled by the English."

THE British School of Archæology at Athens has made further important discoveries on the site of the city of Sparta. The great temple of Artemis Orthia has been now completely cleared. The site known as the Menelaion, at Therapne, about two miles south-east of Sparta, has been partially examined. The sanctuary of Menelaus and Helen, mentioned by Herodotus, Livy, Pausanias, and Polybius, was a favourite resort of the Spartan ladies, where the goddess was believed to confer the gift of beauty on her worshippers. The discovery of Mycenæan remains on this site suggests that this was the famous palace of Menelaus, and this provisional identification is corroborated by finds of bronzes, votive double-axes, lead figurines, and terra-cottas.

IN the fourth Bulletin of the Archæological Survey of Nubia for the current year Dr. G. A. Reisner continues his account of a group of prehistoric cemeteries at Koshtamna, in Nubia. The excavations disclosed two remarkable sets of graves, one simple archaic pits with contracted burials, and the second mud-cut chambers with mummies deposited in an extended position. Unfortunately, many of the former have been destroyed by cultivators in search of fertilising matter for their fields, but those which remain extend from the middle pre-dynastic period down to that of the late Empire. The mud-cut graves represent the period from the earliest Ptolemaic down to Christian times. Drs. G. Elliot Smith and D. E. Derry have, as usual, reported upon the physical characters of the human remains. These show a considerable intermixture of the Negroid with the indigenous type, which has resulted in a progressive shortening of the cranium. Three distinct negro types were observed—one small and relatively short-headed, the second taller and dolichocephalic, the third a big, massive, broad-faced, large-headed variety. The occurrence of spinal tuberculosis in this region is now definitely established, and the present investigations have pushed back the diagnosis of this disease another thousand years, as far back as the period of the Ancient Empire.

THE Transactions of the Royal Society of South Africa for July last contain a useful paper by Mr. R. T. A. Innes, in which he endeavours to show what reductions applied to the Transvaal air-temperatures will in the mean for the whole country reproduce the assumed temperatures at sea-level. On squared paper points were placed for the actual temperatures recorded at different altitudes; a curve drawn through these to the point at sea-level approximated closely to a parabolic form, and from this curve the reductions to sea-level were taken, the figures below 2500 and above 6000 feet being mostly derived by extrapolation. Three maps are given showing the distribution of sea-level temperatures during the warmest and coldest months of the year and for the mean of the year. The isotherms differ considerably from those drawn by Dr. Buchan; in the warmest month, for instance, Dr. Buchan gives the sea-level temperature of the western border as about 92½°, whereas Mr. Innes gives it as 85°. The author remarks that, in the absence of data, Dr. Buchan must have relied on the

analogy with other continental areas, but that the effects of the South African plateau and of the great wind movement alter the circumstances. The present tables, based on data for two years, are, however, only considered as a first approximation.

WITH reference to suggested reforms in meteorological methods, we referred in a recent issue to a proposal made by Prof. A. G. McAdie in the *U.S. Monthly Weather Review* of November, 1908, to adopt the centigrade (not Celsius) scale and the metric system for temperature, wind, rain, &c., and 1000 on an arbitrary scale of units as the equivalent of the normal atmospheric pressure of 760 mm. This proposal has led to several interesting communications on the subject in the *Monthly Weather Review* of March last. Mr. M. E. J. Gheury (Eltham) prefers, for reasons given, the units at present generally adopted for meteorological observations in this country. Mr. H. H. Clayton (Blue Hill, U.S.) prefers the metric system, but with regard to temperature he renews a suggestion, made in NATURE in 1899 (vol. lx., p. 491), that the Kelvin thermometer scale (freezing point 273°, boiling point 373°) should be used, and he points out that the adoption of this scale with the metric system was recommended by a committee of the British Association in 1904. Prof. Köppen (Hamburg) approves of the use of the metric and centigrade systems by England and America, but would express all barometric measurements by ordinary general units of force, taking as unit the product gram × acceleration of gravity. In connection with the above notes it may be stated that from the commencement of this year the Meteorological Office has adopted centigrade degrees on the absolute scale (from −273°) and pressure in C.G.S. units, or megadynes per square centimetre, as most suitable for the publication of values in the investigation of the upper air.

NO. 15 of the *Verhandlungen der deutschen physikalischen Gesellschaft* contains two contributions from Prof. W. Nernst and his pupil, Dr. H. Levy, dealing with the physical properties of water from the thermodynamic point of view. Assuming that the deviations of water vapour from the "perfect gas" laws are due to the formation of a certain proportion of double molecules in the vapour, they show that it is possible to give expressions for the density and pressure of the vapour and the latent heat of evaporation of the liquid, within the interval 0° C. to 100° C., the latent heat of fusion of ice, and even for the variation of the specific heat of water with temperature, which show an accuracy far greater than has been attainable with the help of any previous theory.

SOME experiments by Prof. Rateau on fluid pressure on inclined planes are discussed in an article in *Engineering* for September 17. The mathematical solution for an ideal fluid shows that a portion of the fluid is always deviated so as to pass over the leading edge, whatever may be the inclination of the plane. Rateau's experiments show that, for considerable angles of incidence, the fluid actually spills over both edges, whilst for smaller angles the flow takes place wholly past the trailing edge. Using a rectangular plane 30 by 50 centimetres by 1·25 millimetres thick, from 0 to 29 degrees the flow is solely over the trailing edge; from 29 to 36 degrees the conditions are absolutely unstable; afterwards a proportion regularly escapes past the leading edge. Further, the smaller the angle of inclination the nearer does the centre of pressure lie to the leading edge of the plane, the limiting value for the above plane being 0·236 of the width of the plane for zero inclination. A plate having a flat ship-shaped section shows a very marked retrogression of the centre of pressure at inclinations less than 7 degrees, the centre of pressure moving rapidly towards the trailing edge. A blast of air was used in these experiments, and results were also obtained for the total pressure and for the friction.

FROM an article on the Paris Aviation Exhibition in *Engineering* for October 1 we note a point which may possibly require more attention than it has hitherto received. In the case of an engine running with no fly-wheel except the propeller, the blades near the root may be subject to a considerable stress alternating with every revolution of the engine. The amount of this stress will depend on the number of cylinders the engine has, and it may be necessary to make the propeller-blades considerably stronger with two- and three-cylinder engines having no fly-wheel than with others having a more even turning moment. Wooden propellers seem more in favour than those of metal, and probably are more suitable, as wood is well able to withstand the above-mentioned stresses, and it is easy to make the blade strong at the root without excessive weight. The wreck of the dirigible *République* and the death of four men composing her crew, owing to a broken propeller, shows that danger from this cause is not imaginary, and the results in an aëroplane would probably be at least equally disastrous. We also note from the same article that although the cross-Channel flight and the record for distance have been performed with air-cooled motors, the water-cooled engines are in a very large majority at the exhibition. Weights per horse-power range from 2·2 lb. in the Gnome to 7·5 lb. in the Renault, both being air-cooled. The water-cooled engines range from 4 lb. in the Darracq to 6·1 lb. in the Bayard, excluding radiator and water.

THE Carnegie Institute of Washington has now published the eighth volume of the "Index of Economic Material in Documents of the States of the United States." It deals with the State of Illinois, and covers the years 1809–1904. This index has been prepared by Adelaide R. Hasse, of the Librarian Department of Public Documents in the New York Public Library, and deals only with the printed reports of administrative officers, legislative committees, special commissions, and governors' messages. The term "economic" has been given a liberal interpretation, and the index will constitute a useful addition to the resources of students of American history.

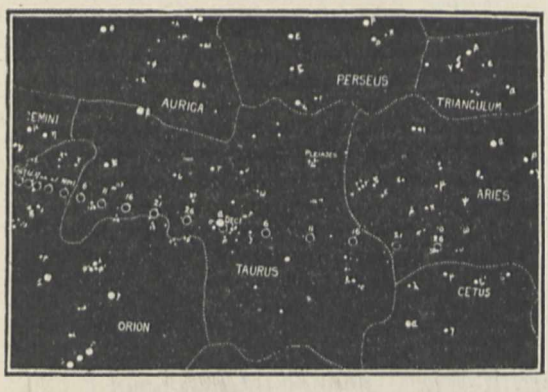
WE are asked to state that a new edition (the third) of "A List of Official Chemical Appointments" is being prepared by the registrar and secretary of the Institute of Chemistry, and that corrections and additions should be sent as soon as possible to the registrar of the institute, 30 Bloomsbury Square, W.C. Suggestions which may increase the usefulness of the list will be carefully considered.

SINCE the appearance in the last number of NATURE of particulars as to forthcoming books of science, information has reached us of the following additional works:—In *Agriculture*.—"Principles of Agriculture: a Text-book for Lecturers on Agriculture, Rural Schoolmasters, Young Farmers, and Students of Agriculture," J. M'Cutcheon, illustrated (E. and S. Livingstone). In *Biology*.—"Window and Indoor Gardening," T. W. Sanders; "Mushrooms and their Cultivation," T. W. Sanders; "Bees for Profit and Pleasure," H. Geary (W. H. and L. Collingridge); "The Mammals of Somaliland: a Book for Naturalists and Sportsmen," R. E. Drake-Brockman, illustrated (Hurst and Blackett, Ltd.); "The Mutation Theory," Dr. H. de Vries, 2 vols., illustrated (Kegan Paul and Co., Ltd.).

In *Geography and Travel*.—"The Basutos: the Mountaineers and their Country," Sir Godfrey Lagden, 2 vols., illustrated (Hutchinson and Co.); "Mediæval Researches from Eastern Asiatic Sources: Fragments towards the Knowledge of the Geography and History of Central and Western Asia, from the Thirteenth to the Seventeenth Century," E. Bretschneider, 2 vols. (Kegan Paul and Co., Ltd.). In *Mathematics and Physical Science*.—New volumes of the International Scientific Series:—"Music: its Laws and Evolution," J. Combarieu; and new editions of "Light and Photography," Dr. H. Vogel and A. E. Garrett; and "Colour-blindness and Colour-perception," C. W. Edridge-Green, illustrated; also "An Easy and Concise Guide to the Starry Heavens," D. M'Ewan, illustrated (Kegan Paul and Co., Ltd.).

## *OUR ASTRONOMICAL COLUMN.*

EPHEMERIS FOR HALLEY'S COMET, 1909*c*.—A corrected ephemeris for Halley's comet is published by Mr. Crommelin in No. 4359 of the *Astronomische Nachrichten* (p. 249, September 28). This ephemeris, like that published in No. 4330 of the same journal, is based on the elements published, for the Astronomische Gesellschaft prize, under the pseudonym "Isti mirantur stellum," Messrs. Cowell and Crommelin, it transpires, being the calculators. The new observations do not yet cover a sufficiently long arc to permit of an independent deter-




mination of the orbit, but they do show that the previously published elements are correct except that the date of perihelion passage must be advanced 3·4 days, thereby making it 1910 April 20·0 (G.M.T.); this modification has been taken into account in preparing the present ephemeris, which covers the period August 28 to December 26 in five-day steps. An extract follows:—

*Ephemeris.*

| Berlin M.T | R.A. (1910·0) | (decl. 1910·0) | log *r* | log Δ | Magnitude |
|---|---|---|---|---|---|
| | h. m. | ° ′ | | | |
| Oct. 17·4 .. | 6 9·7 ... | +16 57 ... | 0·4785 ... | 0·3982 ... | 14·7 |
| ,, 22·4 ... | 6 5·1 ... | +16 56 | | | |
| ,, 27·4 ... | 5 59·1 .. | +16 54 ... | 0·4608 ... | 0·3447 ... | 14·2 |
| Nov. 1·4 ... | 5 51·7 ... | +16 52 | | | |

From this we see that the comet is at present in the northern limits of Orion, and is some 280 and 230 million miles from the sun and earth respectively; also that it is approaching the sun and the earth at the respective rates of about 1·12 and 2·7 million miles per day. The accompanying chart shows its positions in relation to the constellations so far as Mr. Crommelin's ephemeris gives them.

CHANGES ON MARS.—In No. 4359 of the *Astronomische Nachrichten*, M. R. Jonckheere, of the Observatoire d'Hem (Roubaix), gives a drawing of the south polar cap of Mars, executed on September 2, showing the new "land" which he discovered in longitude 120°. He points out that the crevasse and greyish region observed by M. Jarry Desloges are produced by the emersion of the two "lands," Argyre II. (longitude 60°) and the new one, from the polar snows. For the newly discovered area in longitude 120° he proposes the name "Stella," suggested by its brilliant appearance.

In the same journal M. Antoniadi records his observations, on September 19, of the Mer du Sablier, which to him appeared as Dawes recorded it in 1864. As Prof. Lowell's observations and photographs show it of a very different form during the period 1894–1907, M. Antoniadi suggests that periodic changes of form, probably irregular, may take place in this feature.

A number of interesting observations of the planet are recorded in No. 22 of the *Gazette Astronomique*, by M. P. L. Dupont, of Hoboken, Antwerp.

REMARKABLE METEORS.—No. 22 of the *Gazette Astronomique* contains the records of three remarkable meteors seen in Denmark during August. The first was at 9h. 25m. (C.E.T.) on August 19, and it was bright enough to illuminate the surrounding landscape. Apparently its actual path was from 128 km. above the town of Sorö, in Zealand, to 30 km. above a point on the coast about 22 km. west of Sorö; thus the path was nearly vertical, and the velocity was about 33 km. per second. The other two meteors were seen on the same night at 9h. 17m. and 9h. 38m. respectively. The former was attended by a noise similar to that made by escaping steam, whilst the second one was extraordinarily slow, and was seen for fifteen seconds, during which it passed, nearly horizontally, from 190°, +23° to 152°, +32°.

THE URSA-MAJOR SYSTEM OF STARS.—Following up Dr. Ludendorff's conclusion that the stars $\beta$, $\gamma$, $\delta$, $\epsilon$, and $\zeta$ Ursæ Majoris belong to a definite system of stars moving along parallel lines in space, Mr. Ejnar Hertzsprung has investigated the conditions for other stars having similar proper motions, and finds that a number of other stars probably belong to the same system. Among these may be noted $\beta$ Aurigæ, Sirius, $\alpha$ Coronæ, 78 Ursæ Majoris, and Groombridge 1930, while $\kappa$ Boötis is suspected. A number of the stars, nine out of fifteen given, are double, and a tabulation of the magnitudes and spectral classes suggests a development of spectrum, from one star to another, with an attendant decrease of brightness (*Astrophysical Journal*, vol. xxx., No. 2, p. 135).

SEARCH-EPHEMERIS FOR WINNECKE'S COMET.—A continuation of the search-ephemeris for Winnecke's comet is published by Herr C. Hillebrand in No. 4360 of the *Astronomische Nachrichten*. As the present southerly declination (−20°) is increasing, it is not likely that the comet will be generally observed in the northern hemisphere.

THE NATURE OF SOLAR FACULÆ.—An important result concerning the nature of bright faculæ seen on the sun's disc is published by M. Deslandres in No. 11 of the *Comptes rendus* (p. 493, September 13). The main conclusion is that the vapours in the bright faculic areas are, relatively to the surrounding dark areas, descending. This result has been deduced from the measures of the motion-displacements shown on negatives taken with the Meudon spectro-register of radial velocities, the pure $K_3$ line being employed.

Exhaustive measures of the absolute velocities have not been made, because to measure completely the whole disc on one negative would entail some 36,000 settings, and the Meudon staff is not sufficiently large for such an enterprise. But the measures of a number of displacements on bright areas near the centre of the disc, where the line-of-sight motions are independent of the solar rotation, indicate that the result is general. A diagram which accompanies the paper shows this result for a faculic area photographed on June 4.

M. Deslandres discusses this result in comparison with atmospheric movements on the earth, and suggests that it is in accordance with theory. When a mass of vapour descends it becomes compressed, and therefore brighter; when ascending, its pressure is decreased, and consequently the vapour becomes cooled and less bright.

The investigation of the nature of spots, on the same lines, has not yet been undertaken, M. Deslandres looking upon spots as a secondary phenomenon following the production of faculæ.

## PERCY SLADEN MEMORIAL EXPEDITION IN SOUTH-WEST AFRICA, 1908–9.

### I.

THE Percy Sladen Memorial Expedition was the outcome of a recent study of Welwitschia, that most remarkable of West African plants. Its primary object was the investigation of the biology and morphology of *Gnetum africanum*, the only immediate relative of Welwitschia known to occur south of the Congo. It was further proposed to examine, so far as circumstances would allow, the flora of the desert-belt and of the regions adjacent to it. The expedition was under the auspices of the trustees of the Percy Sladen Memorial Fund, and was assisted by a grant of 200*l.* from the Royal Society. During the first section of the journey (Cape Town to Lüderitzbucht) I was fortunately able to travel in company with the magnetic survey expedition of the Carnegie Institute under my colleague, Dr. J. C. Beattie. A saving of half the ordinary cost of transport was thus effected. The route followed was very largely determined by the distribution of the usually widely separated water-holes. What would certainly have proved a very interesting part of the journey (viz. from Keetmanshoep to Windhuk) had to be abandoned owing to the necessity of arriving in central Angola before the end of the season in which suitable stages of the ovules of Gnetum were likely to be obtainable.

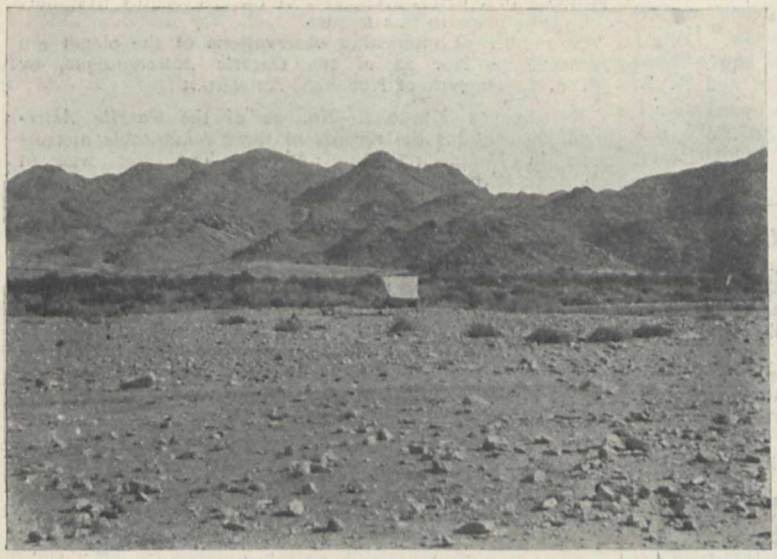


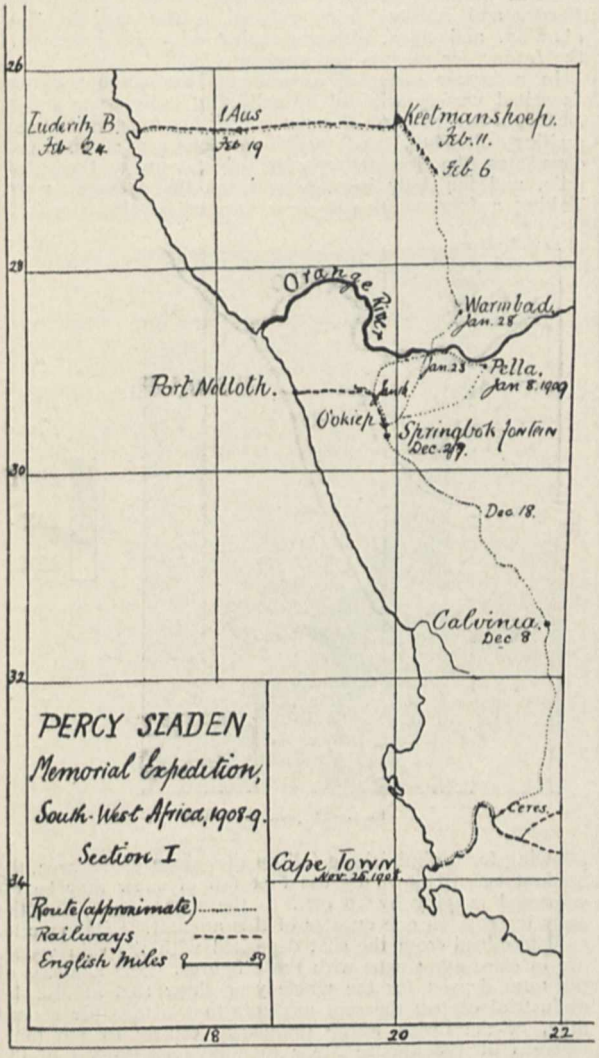
FIG. 1.—A view across the Orange River near Raman's Drift, looking North. The river itself is concealed by the lowest zone of vegetation.

Leaving Ceres Road Station on November 26 with a waggon drawn by twenty oxen, we ascended to the Ceres Plateau (1100 feet) through Mitchell's Pass in the Langeberge Range, and travelled for four days over an undulating tableland rising to 2500 feet, the flora of which is closely related to that of the mountainous districts of south-western Cape Colony. Unfortunately, most of this country was suffering from drought, and the botanical results were poor. At Karoo Poort we suddenly emerged upon the western tongue of the Karoo (November 30), which was crossed in six days. Here also the ground was parched; in some districts, it was stated, no rain had fallen for four years, and many of the farmers had migrated with their families and flocks into Bushmanland and other more favoured localities leaving their homesteads unoccupied. Over large areas all the non-succulent vegetation had disappeared and the flora consisted almost entirely of *Augea capensis* with a few species of Mesembrianthemum. Ascending the Blauwkrantz Pass in a spur of the Roggeveld Range on December 6, we came upon a plateau the flora of which is closely related to that of the Nieuveldt Mountains in the neighbourhood of Beaufort West. On December 10 a somewhat sudden descent to 1600 feet brought us again into a karoid region, in which species characteristic of the dry, low-lying plateaux of Great Namaqualand were encountered for the first time. Prominent among these were *Tamarix articulata*, *Aloe dichotoma*, *Statice scabra*, *Galenia articulata*, *Didelta annua*, *Exomis albicans*, and *Vogelia africana*. This southern extension of the flora of tropical and subtropical Namaqualand seems to be confined to sheltered valleys at elevations not exceeding 2000 feet.

From O'okiep a detour to the north-east across the sandy plains of Bushmanland was rewarded by an unexpectedly rich collection, for unusually heavy rains had recently fallen. The plains were gay with the flowers of *Hoodia Gordoni*, *Rhigozum sp.*, and a tall bushy Hermannia. A shrubby Aristida and some smaller species of the same genus were also very abundantly represented, while trees of *Aloe dichotoma* and large symmetrical bushes of species of Euphorbia were conspicuous on the "kopjes." The natural vegetation along the banks of the Orange River forms a narrow belt, in which a distinct arrangement in subordinate zones can usually be traced. The lowest zone (Fig. 1) consists of a dense scrub of *Salix capensis*, *Acacia horrida*, *Zizyphus mucronata*, and a few other bushes, with some grasses, reeds, and sedges. Above the primary bank of the river the mountains rise steep, rugged and barren, or, between them and the stream, are stony flats (Fig. 1) all but devoid of vegetation. Having returned to O'okiep to refit, we arrived at Raman's Drift for the second time on January 22, and crossed to the German side on January 24. The river at this time was in flood, and its muddy waters were some 600 yards wide at the drift. A few hours of heavy travelling brought us upon a plateau (2300–4000 feet)

FIG. 2.—Great Namaqualand south of Warmbad, *Aloe dichotoma*, *Euphorbia sp.* The native is a Bondelzwaart.

where the vegetation proved to be richer than any hitherto met with. It was said that the rains which had fallen a few months earlier were more copious than any experienced during the previous fifteen or twenty years. It was no doubt a consequence of this that the annual constituents of the flora were unexpectedly abundant. Warmbad is noted for a number of warm springs (35° C.) the waters of which—like so many of the natural waters of the south-west coast—are impregnated with sulphuretted hydrogen. The railway between Keetmanshoep (3300 feet) and the sea ascends to nearly 5000 feet at !Aus, where the vegetation presents many karoid features. From !Aus the descent—at first gradual, later more rapid—is uninterrupted. About 30 km. west of !Aus (110 km. from the coast) the desert commences very abruptly at 2700




feet. In this latitude there appear to be few forms peculiar to the desert itself and its flora consists very largely of the more resistant of the species found at higher levels and under less arid conditions. Nevertheless, the eastern boundary of the desert is remarkably sharp, and approximately coincides with the western limit of precipitation from clouds condensed upon the neighbouring highlands. Within 50 km. of the sea the sharp, bare mountain peaks and ridges are frequently more or less buried in sand-dunes, the materials of which are blown up from the lower-lying flats, leaving behind the worn gravels from which diamonds are now being obtained over an extensive area. Nearer the coast the scenery is remarkably gaunt and rugged and the wind-swept surface is frequently quite bare of vegetation.

Leaving Lüderitzbucht by sea on February 26, I arrived in Swakopmund eighteen hours later, and on March 2 reached Welwitsch (lat. 22°), a Welwitschia locality previously visited in 1907 in company with Mr. E. E. Galpin.[1] The object of this visit was to obtain later stages of the Welwitschia embryo than were present in material collected in 1907. The flora in general was this year very much poorer than two years earlier. Not only were many of the smaller plants then collected not found at all, but woody species formerly obtained in flower or fruit now showed no signs of reproductive activity; this also applies to some extent to Welwitschia itself, for only a small proportion of the plants had coned. The explanation of this very striking difference seems to be contained in the meteorological records. Between[2] November 1, 1906, and January 31, 1907, 12·8 mm. of rain were measured at Welwitsch; in the corresponding period of 1908–9 the rainfall was 5·9 mm. In December, 1906, the fall was 12·5 mm., an amount very much in excess of that recorded for the whole of each of the years 1907 and 1908. We have here, then, another example of the remarkable influence of a small additional rainfall upon both the annual and perennial constituents of a desert flora.

A large number of the Welwitschia plants present in 1907 in this easily accessible locality have been removed in the interval, and, at the same rate, a few years would probably have seen the complete disappearance of all plants from the vicinity of the railway, for there is here no sign of seed-reproduction. It is therefore very satisfactory to note that His Excellency the Acting Governor has issued instructions for the protection of the plants that remain.

H. H. W. PEARSON.

## *RESEARCHES ON THE ACTION CENTRES OF THE ATMOSPHERE.*[3]

IN the domain of world meteorology, that is, the comparison and discussion of meteorological data of widely distributed stations over the earth's surface, Prof. H. Hildebrand Hildebrandsson has, during the last decade or so, been making some very important communications. He has clearly emphasised the fact that the laws which rule the general movements of our atmosphere will never be found if observations are only made in civilised countries on the earth's surface. Our atmosphere is a mass of air resting both on the continents and the oceans, and modern researches have shown that a large perturbation at one time in one area may be intimately associated with a perturbation of an opposite nature in the antipodal part of the world. Although several workers many years ago intimated the positions of isolated areas which behaved in a reverse or see-saw manner meteorologically, it was Prof. Hildebrandsson who first directed attention to a great number of such areas. In more recent times these isolated instances of barometric see-saws have been found to be part of really one general law applying to the movements of our atmosphere. This general law has yet to be more minutely investigated, for it is, as Prof. Hildebrandsson states, "une verité avec des grandes modifications." There is little doubt, nevertheless, that world meteorology has made a considerable advance since the discovery of these simultaneous reverse-pressure changes, and one is now in a much better position to state where on the earth's surface observations should be made.

Every attempt should therefore be made to utilise islands in the large oceans, even if the sole occupants of the islands are the meteorological observers themselves, for until the air movements over the oceans are carefully observed and recorded we shall still be left to a great extent in the dark.

Prof. Hildebrandsson's most recent memoir deals chiefly with the northern latitudes of the northern hemisphere, and is devoted to a discussion of data with respect to the simultaneous compensation between types of seasons in different regions. The meteorological data here dealt with relate mainly to certain regions between the east coast of

1 NATURE, vol. lxxv., p. 536.

2 Meteorological observations at this station were commenced in November, 1906.

3 Kungl. Svenska Vetenskapsakademiens Handlingar, Band 45, No. 2. III. "Sur la Compensation entre les Types des Saisons simultanés en différentes Régions de la Terre." By H. Hildebrand Hildebrandsson.

North America and Siberia, but some more southern stations are included.

Without going into any great detail, the investigation may be summarised as follows. Prof. Hildebrandsson regards the state of the ice of the polar sea as being the principal cause of the different types of the seasons of different years. Thus a high summer temperature in the arctic sea to the north of Europe will set free a large amount of ice, and consequently the polar current arriving on the north coast of Iceland in February and March, and a branch of which, after skirting the east coast, is directed towards the North Sea, will bring much ice and will be surrounded by a layer of cold water. This current will cool the air in its neighbourhood. The result of the movement southward of these specially cold currents is that the land areas around the Arctic Circle and North Atlantic Ocean suffer *successively* from them by the lowering of their air temperatures. Prof. Hildebrandsson accompanies his statements with tables and an excellent series of curves, which are very convincing. He specially refers to the investigation of M. Peterson, who showed that a variation of 2° or 3° in the surface temperature of the sea is sufficient to create changes of considerable magnitude in the air temperature over very large areas.

The main result of this research is to indicate that in certain cases a means is afforded of making forecasts for seasons. Thus, to take an example, he shows that, with two or three exceptions, in twenty-five years the temperature of the summer at the North Cape was in the following spring in opposition to that of Europe, represented by Debreezin.

## *THE NATURE AND EXTENT OF AIR POLLUTION BY SMOKE.*[1]

IN a former paper read at the Congress of the Sanitary Institute held at Leeds in 1897 an account was given of the quantity of soot suspended in and deposited from the atmosphere of Leeds. It was then shown that, on the average working day, 20 tons of soot are sent into the air of Leeds, of which half a ton falls on an area of four square miles, and of the latter from 20 lb. to 25 lb. stick, that is, are not removable by rain. The present paper contains a record of the atmospheric impurities carried down by rain and the effect of this rain water on vegetation. It also contains an inquiry into the diminution of daylight caused by suspended particles of soot.

Ten representative stations were selected in Leeds and one at Garforth, about 7½ miles due east of Leeds. The impurities, in the form of suspended matter, consist of soot, tar, sand, mineral substances, and, in solution, of sulphurous and sulphuric acids or their salts, chlorides, largely in the form of hydrochloric acid or common salt, and nitrogenous matter, in the form of nitrates or free and albuminoid ammonia. The results are embodied in the following table :—

ANALYSES OF RAIN WATER, LEEDS AND GARFORTH.

*Total for Year, expressed in Pounds per Acre.*

| | Collecting station | Suspended matter | Tarry matter | Mineral matter | Free acidity as $H_2SO_4$ | $SO_3$ | $SO_2$ | Chlorine | Nitrogen as $NH_3$ | Nitrogen as $N_2O_5$ | Nitrogen as albuminoid ammonia | Total nitrogen |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industrial | 1. Leeds Forge. | 1886 | 110 | 1113 | 35 | 123 | 34 | 164 | 13·0 | 0·0 | 4·7 | 17·7 |
| | 2. Hunslet .... | 1565 | 69 | 655 | 90 | 185 | 24 | 198 | 15·5 | 0·0 | 2·9 | 18·4 |
| | 3. Beeston Hill. | 1163 | 149 | 709 | 30 | 269 | 54 | 101 | 14·4 | 0·5 | 3·5 | 18·4 |
| | 4. Philosophical Hall (Town) | 849 | 78 | 423 | 45 | 149 | 38 | 75 | 14·4 | 0·3 | 2·2 | 16·9 |
| Residential | 5. Headingley.. | 659 | 43 | 199 | 11 | 118 | 32 | 41 | 11·1 | 1·1 | 0·8 | 13·0 |
| | 6. Armley .... | 593 | 34 | 216 | 29 | 110 | 37 | 108 | 9·9 | 1·0 | 3·2 | 14·1 |
| | 7. Observatory. | 399 | 32 | 146 | 26 | 85 | 39 | 51 | 8·4 | 0·8 | 1·6 | 10·8 |
| | 8. Kirkstall .... | 352 | 28 | 141 | 8 | 77 | 56 | 57 | 7·7 | 0·2 | 2·3 | 10·2 |
| | 9. Weetwood Lane | 147 | 26 | 54 | 11 | 82 | 13 | 34 | 8·3 | 1·1 | 2·1 | 11·5 |
| | 10. Roundhay .... | 90 | 14 | 49 | 0 | 53 | 16 | 38 | 5·8 | 0·7 | 1·3 | 7·8 |
| | 11. Garforth (Country) | — | — | — | 28 | 65 | 21 | 22 | 5·0 | 3·2 | 1·1 | 9·3 |

[1] Abstract of a paper by Prof. J. B. Cohen and Mr. A. G. Ruston read at the Health Congress held at Leeds on July 17.

The solid impurities were found to diminish rapidly in passing northwards from the centre of the town. Within the distance of a mile the quantity fell to less than half, and at 2½ miles to less than one-fifth.

The influence of the industrial centres upon the solid impurities stands out most conspicuously, as a glance at the table will show, *i.e.* in the chief industrial centres the solid impurities are roughly twenty times as great as in the purer atmosphere of Roundhay, about three miles north-east of the centre of the town (Fig. 1).

The quantity is also determined by the prevailing winds, which are west, south-west, and north-east, and the drift of the impurities is consequently more towards the east than the west. Of the three constituents of the total suspended matter, the one which is least injurious is the mineral matter. This is abnormally high at the Leeds Forge, and consists principally of oxides of iron, lime, alumina, and silica, either escaping with the fumes from the furnace or thrown out mechanically.

In a former series of experiments the amount of soot deposited was determined by collecting daily from a fresh surface a square yard of snow (which lay for several days), melting, filtering, and weighing the soot. The total deposit on the first day represented 16 cwt. to the square mile, and the daily increase was, on the average, 4 cwt. Taking a four-square-mile area covered by the town, and

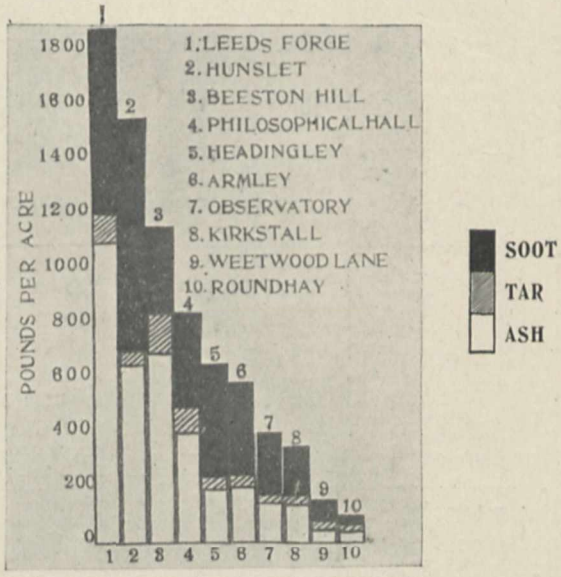



FIG. 1.—Suspended Matter.

allowing for a diminishing fall on the fringe of the area, the amount carried down by the first fall of snow may be represented roughly by 10 cwt. to the square mile, and the daily increase as one quarter of this amount. Later results, as determined from the soot deposited with the rain water, are in close agreement with these figures. The analyses of the total deposit for the whole year show that at Hunslet (industrial centre) the soot amounts to 300 tons per square mile, at the Leeds Forge (industrial centre) to 250 tons, whereas at Woodhouse Moor (one mile north-west of the centre) it dropped to 80 tons. Taking the average of the stations which lie within the central four-square-mile area, we get 190 tons per square mile per year, or roughly half a ton per square mile per day.

The amount of tar deposited with the soot was previously demonstrated by exposing glass plates 1 foot square at different points situated in and at distances from the town. These plates at intervals were washed under running water, and the residual deposit analysed. The amount of soot thus remaining, as determined from its carbon content, was found to be twenty-four times greater in the town than at a distance of nine miles. In the present experiments the tarry matter was estimated by extraction with ether. The quantity dropped from 80 lb. per acre per annum in the centre to 14 lb. per acre at a distance

of three miles north-east of the town. The waste of fuel in the form of unburnt coal passing into the atmosphere is represented each year by about 300 tons per square mile in the centre of the town, or, over the whole area of four miles square, about 100 tons per square mile. The effect of these suspended impurities in diminishing the amount of sunlight in Leeds may be gathered from the fact that in 1907 the number of hours of bright sunshine was 1167 in the town, whilst four miles north-west it reached 1402 hours. The amount of daylight has also been recorded at two different periods by the quantity of iodine liberated from an acid solution of potassium iodide. On the first occasion, over a period of four winter months, it was shown that the smoke in an industrial centre absorbed one-quarter of the daylight as compared with a station one mile to the north-west. In the present investigation, carried out during the month of June of this year, the amount of daylight often fell to one-half in the centre of the town as compared with Garforth several miles away. The relation of soot deposit (black column) to daylight (light column) is shown in the diagram (Fig. 2).

It is the tarry matter in the soot which causes the latter to adhere to and blacken buildings and vegetation. It is sometimes stated that it is the domestic smoke rather than industrial smoke which is injurious to plant life, on

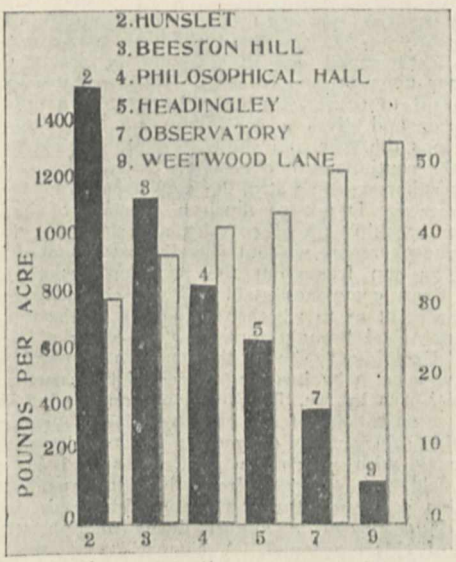



FIG. 2.—Influence of Suspended Matter on Intensity of Light.

account of its higher content of tar. There is a certain justification for this statement, for the percentage of tarry matter in the total solid impurities is highest in the residential and lowest in the industrial areas, varying from 18 per cent. in the former to 4 per cent. in the latter. When, however, account is taken of the total tarry matter deposited each year, the industrial centres are responsible for the greater quantity, which reaches in some cases ten times the amount in the residential districts. The total sulphur, either as sulphurous or sulphuric acid, is everywhere high, but particularly in and near the chief manufacturing areas. A large portion of the free acids is neutralised either by the alkaline fumes of the blast furnaces or by the ammonia of the burnt coal. Still, free acid is present in considerable quantity, and in Hunslet (industrial centre) represents an annual deposit of 90 lb. per acre, or 25–30 tons per square mile.

It is the sulphurous acid which imparts to town fog its choky and irritating effects. The large amount of this acid present in fogs may be gauged from the fact that the hoar-frost collected during the dense fog of January 27 contained acid corresponding to 10·29 parts per 100,000, or more than ten times the average acidity of the same station.

To demonstrate the detrimental effect of sulphuric acid upon vegetation, Timothy grass was sown on May 12, 1908, in boxes 1 foot square, the soil being uniform. The seed was watered at a rate corresponding to the average rainfall of 25 inches with water containing different amounts of sulphuric acid. In addition to this, three other samples were watered with Garforth rain water in which the acidity was neutralised, the second with ordinary Garforth rain water, and the third with Leeds rain water. The results were very instructive. In the case of Leeds rain water and of those waters containing a higher degree of acidity, germination was distinctly checked, and the delicate green of the young grass quickly changed to yellow or brown. Grasses watered with water containing 32 parts per 100,000 were killed in a little more than three months, and with 16 parts per 100,000 in less than a year.

Chlorides are found in large quantities, especially in the industrial centres, where, expressed as common salt, they sometimes reach as much as 3 or 4 cwt. per acre, a quantity which must be distinctly prejudicial to vegetation.

The nitrogenous impurities, on the other hand, would be beneficial by acting either as direct stimulants and fertilisers or by neutralising the acidity of the sulphur and chlorine compounds.

## MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE proceedings of Section A began on Thursday, August 26, with the address of its president, Prof. E. Rutherford, F.R.S., which has already been printed in full in these columns (NATURE, August 26, p. 257).

A paper followed, by Prof. J. H. Poynting and Mr. Guy Barlow, on the pressure of radiation against the source. The authors employ thin slips of material which become heated by incident radiation. Those black on both sides experience a pressure equal to the energy-density, P, of the incident radiation; those black on the incident side and brightly silvered on the other experience a pressure 1·67 times as great, the excess being due to the radiation which is emitted by one side only of the plate. Plates which are bright both sides experience a pressure 2P, because they do not become heated. Experiments, which are in progress, give good accord with theory. In a short discussion which followed, Prof. Hull intimated that he was alive to the possibility of this reaction when making his experiments on the pressure of incident radiation, but his experiments had been devised carefully so as to prevent its occurrence.

Prof. T. Lyman then gave a summary of the ascertained properties of light of very short wave-lengths ("Schumann rays"), including their ionising and photoelectric effects. To these Prof. Bumstead added that one of his students had shown that the velocity of the electrons emitted photo-electrically increases directly as the frequency of the light up to a wave-length $\lambda = 1250$—a result which Ladenburg had previously shown to hold good for ordinary light.

Prof. Percival Lowell followed with an account of the photographs of Jupiter taken at the Lowell Observatory. The slides exhibited showed a wonderful amount of detail, the most noteworthy features being faint wisps that criss-cross the several belts, particularly the bright equatorial one. He explained the belts and wisps as gaps in the clouds formed by condensing of uprising vapours from Jupiter's heated interior (he being still a semi-sun), and strung out by his rotation. Prof. Larmor added greatly to the interest of the paper by exhibiting some early drawings of Jupiter made by Sir W. Huggins, and stated that Sir William's opinion from the first was that the wisps were the edges of cumulus clouds. He noted that the high albedo of Jupiter (72) indicates that the Jovian atmosphere acts like a bright cloud; it follows that very little of the meteorology of Jupiter can be due to the sun if heat is only absorbed like light. Other planets with a low albedo would have surface markings more like terrestrial ones. The day's proceedings concluded with a paper, by Prof. E. E. Barnard (read by Prof. E. W. Brown), on the motion of some of the small stars in Messier 92 (Herculis). Two of the stars in this cluster are shown to have proper motion; the first (No. 11 of Schultz's list) is moving awa-

from the centre of the cluster; the second one is moving towards the centre. Several others in the cluster appear to have a slight motion.

On Friday, August 27, owing to the large number of papers presented to the section, it was divided into three departments, which met concurrently. In the mathematical department, Prof. E. H. Moore dealt with fundamental analogies existing in diverse branches of mathematics, and proposed a method for unifying these branches in a more general theory embracing all such analogous branches. Further information with regard to Prof. Moore's theory will be found in a paper by him on a form of general analysis with applications to linear differential and integral equations (*Atti del IV. Congresso Internationale dei Mathematici*, vol. ii., pp. 98–114), and in a memoir entitled "Introduction to a Form of General Analysis," which will shortly be published by the Yale University Press. Prof. E. H. Hobson, in a paper on the present state of the theory of aggregates, considered a number of points in connection with the theory, and indicated the desirability of a new and more adequate definition of an aggregate of a more restricted character than the one due to G. Cantor, and of such a character that no difficulties would arise from the ascription of a cardinal number to each such aggregate, and also of an ordinal type in case the aggregate is an ordered one. Prof. G. A. Miller, in a paper on generalisations of the icosahedral group, considered the group the two generating operators of which satisfy one of the following three sets of conditions:—

$$t_1^2=t_2^5,\quad (t_1t_2)^3=(t_2t_1)^3;$$
$$t_1^2=t_2^3,\quad (t_1t_2)^5=(t_2t_1)^5;$$
$$t_1^3=t_2^5,\quad (t_1t_2)^2=(t_2t_1)^2.$$

Amongst other theorems, Prof. Miller proves the following:—There is an infinite number of groups each of which may be generated by two operators satisfying one of these conditions. Each of the possible groups generated by $t_1t_2$ contains either the icosahedral group or the group of order 120, which is insoluble and does not contain a subgroup of order 60, and it must have one of these groups for its commutator subgroup. Prof. G. A. Bliss followed with a new proof of a theorem of Weierstrass concerning the factorisation of power series which states that any convergent series in $p+1$ variables, $F(x_1, x_2, x_3, \ldots x, y_p)$ in which the lowest term in $y$ alone is of degree $n$, can be expressed as a product

$$(y^n+a_1y^{n-1}+\ldots+a_{n-1}y+a_n)\,\Phi\,(x_1\ldots x_p, y),$$

where $a_1, a_2 \ldots a_n$ are convergent series in $x_1, x_2 \ldots x_p$, which vanish with these arguments, while $\Phi$ is a convergent series in all $p+1$ variables with a constant term different from zero. The author also gave formulæ by which the coefficients in the different series may be computed. Mr. J. H. Grace read a paper in which a treatment was given of ideals in a quadratic field, and Prof. W. H. Metzler one on a continuant of order $n+1$ which is expressible as the product of $n+1$ factors. Prof. Ellery W. Davis gave a complete representation of the elements of the central conic the axes of which are non-similar complex quantities. In a paper on the invention of the slide rule, Prof. F. Cajori sifted the evidence in connection with this subject bearing on the rival claims of Gunter, Oughtred, and Wingate. His conclusion is that the slide rule was undoubtedly invented by William Oughtred in 1832. Papers by Major P. A. MacMahon on a correspondence in the theory of the partition of numbers, and by Mr. J. W. Nicholson on the asymptotic expansion of Legendre's functions, were read in title only in the absence of the authors. The like fate overtook the report of the committee on the further tabulation of Bessel functions. This committee has made further progress during the year. Using the notation of previous reports, values of $Q_n(x)$ have been calculated for integral values of $n$ from $n=1$ to $n=6$. From these the values of $\sin^{-1}(Q/R)$ have been computed for the same values of $n$, and the values for $n=\frac{1}{2}, 1\frac{1}{2}, \ldots 6\frac{1}{2}$ have been added. From the tables of the present report and those of the 1907 report, the values of $J_n(x)$ for values of $n$ from 0 to $6\frac{1}{2}$ at intervals of $\frac{1}{2}$, and for values of $x$ greater than 10, can be computed to six places without sensible error. The Neumann function $Y_n(x)$ can be calculated from the same data.

Meanwhile, the department of general physics was holding a joint meeting with Section B (Chemistry). The papers of more particularly chemical interest will be referred to in the report of the proceedings of that section. Prof. E. Goldstein led off the physical papers with one on the three-fold emission spectra of solid organic compounds, which the council has ordered to be printed *in extenso*. Prof. Goldstein finds that aromatic substances solidified by liquid air can emit three discontinuous spectra, which are quite different from one another, when they are exposed to kathode rays. First, the *initial* spectra are observed at the beginning of the luminescence; when these become fainter the *chief* spectra, which are very characteristic for each substance, appear; the *solution* spectra are observed when the aromatic substance is dissolved in another medium and the frozen mixture is exposed to kathode rays. All three spectra commence in the red; the initial spectra extend to the ultra-violet; the chief spectra are shorter. Very characteristic solution spectra are given by naphthalene and its derivatives. The solution spectrum varies with the solvent medium. Very small quantities of aromatic bodies are sufficient to give marked solution spectra; on the other hand, the phenomenon gives a very sensitive method of detecting slight impurities. In this way it may be stated that until now no aromatic substance has been prepared in a really pure state. In the consequent discussion Sir J. J. Thomson pointed out that the results would have been clearer if kathodic rays of only one velocity had been employed. Changes come in very abruptly as the energy of the rays passes a certain value. Experiments are in progress in the Cavendish Laboratory upon lithium chloride. With ordinary kathode rays ($v=10^9$ to $6\times10^9$) the chloride exhibits a steely-blue appearance, and gives a continuous spectrum; but with positive ions the spectrum shows the lithium red line and very little continuous background. As to the origin of these phosphorescent spectra, he emphasised the fact that phosphorescence is not so much a question of ionisation as of the breaking up of complex aggregates, *e.g.* iodine vapour phosphoresces without showing any sign of ionisation. You can freeze out the phosphorescence, thereby making these complexes stable. Prof. H. E. Armstrong raised the point as to whether something of the same sort as Goldstein had brought forward goes on in a Welsbach mantle. Experiment shows that you can obtain phosphorescent spectra by inserting traces of rare earths. The next paper was by Mr. E. F. Burton, on the influence of electrolytes on colloidal ferric oxide solutions. A commercial ferric oxide solution was dialysed in conductivity water, and the velocity with which the particles moved in a unit electric field was observed from time to time. As the purification continued the velocity at first increased, but afterwards decreased in almost linear relation with the amount of chlorine found. A comparison of the coagulating powers of monovalent, divalent, and trivalent ions on the colloidal particles indicates that the Linder-Picton-Hardy law holds good. This paper was followed by one by Dr. Otto Hahn, on methods of separation of radioactive products. These methods are based on the working hypothesis that single radio-active products emit only one type of radiation, either homogeneous α particles or homogeneous β particles. This hypothesis requires that thorium C and actinium B be complex. Also, radium C must be complex, and consist of three products, one emitting α particles and two emitting different β particles. Experiments using a "recoil" method seem to support these conclusions. The author also has found that radium itself emits β as well as α particles; it also must be complex; and experiment seems to show that the β particles come from radium itself, the well-known α particles being due to a new body, radium X. Prof. Rutherford, in commenting upon the paper, pressed the bearing of the results upon the supposed purity of ordinary "chemically pure" bodies. Sir J. Larmor asked for an explanation of the well-known difficulty in connection with the emanation being positively charged after emitting a positively charged body, and in reply Dr. Hahn expressed his belief that δ particles are simultaneously expelled. In answer to a question of Prof. Bumstead's, Dr. Hahn replied that he had not made any magnetic experiments to test the homogeneity of his various rays. Prof. J. C. McLennan then

read a paper on the secondary rays excited in different metals by α rays. He finds that the secondary rays emitted by a selected metal when bombarded by the α particles from polonium deposited on copper are proportional to the α radiation, but that different metals are not equally active, the secondary radiation varying from 62 for platinum to 47 for aluminium. δ radiation excited by polonium appears to be independent of the metal which carries the polonium, and is probably produced by and accompanies the α particle in the course of its expulsion from the polonium atom. Prof. McLennan continued with a paper by Mr. V. E. Pound, on some phenomena associated with the radiations from polonium. By measuring the electrical charge acquired by an insulated metal plate B placed close to and facing an insulated copper plate A bearing a deposit of polonium, it was made clear with the aid of moderate electric and magnetic fields that there are present (1) α rays emitted by the plate A; (2) an easily absorbed secondary negative radiation emitted by B; and (3) an easily absorbed δ radiation emitted by A. An additional negative stream seemed to arise from the polonium in stronger fields; from its behaviour it is considered to consist of streams of rest-atoms from the active product RaG or polonium. Dr. O. Reichenheim followed with an important paper, ordered to be printed *in extenso*, on anode rays and their spectra. He explained that the conditions for the production of anode rays, or striction-anode rays, are:—(1) the presence of positive ions, produced by heated salts of the alkalis or alkaline earths serving as anode; (2) a high fall of potential at the anode, which is produced by the presence of halogen vapours in the tube, and is the origin of the high velocity acquired by the ions, so that they appear as rays in the tube. A new kind of positive rays passes through a perforated anode under a high gradient of potential. These are called $A_1$ rays, because they are analogous to the $K_1$ rays or retrograde rays which leave the kathode. The spectra of anode rays are very simple, often simpler than the arc or spark spectra. The rays show the Doppler effect; in the case of the earth-alkaline rays shifted lines only were found, without any line in the unshifted position. This seems to arise from the fact that we have here to deal with moving particles which emit other lines than the surrounding luminescent gas. A paper by Dr. H. L. Bronson and Mr. A. N. Shaw, on Clark and Weston standard cells, was taken as read owing to lack of time. It dealt with the accuracy and reproducibility of these cells. The mean of five set up in the National Physical Laboratory differs from the mean of the cells set up in Montreal by 5 microvolts. The maximum deviation of their own cells from their mean was only 31 microvolts. The ingredient of main importance is the mercurous sulphate. The ratio of their Weston cells to their Clark cells is 0·716953 as against the value 0·716958 determined by Wolff and Waters. Prof. Rutherford concluded with a paper on the action of α rays upon glass, in which he detailed results analogous to the naturally occurring action due to specks of beryl in rock which had been microscopically detected by Prof. Joly.

In the department of cosmical physics, which met simultaneously, Dr. L. A. Bauer gave a *résumé* of some of the chief results of interest obtained in the magnetic work of the past ten years carried out under his direction by the U.S. Coast and Geodetic Survey and the Carnegie Institute of Washington.

From the detailed magnetic survey of the United States he found that it would not be possible to represent the observed quantities satisfactorily by a general series of spherical harmonics without using a prohibitive number of terms. He found, moreover, by calculating the line integral of the magnetic force around closed circuits, one of which enclosed the whole of the United States, that a part of the magnetic force, 1/300 to 1/500, must be due to non-potential systems, *e.g.* vertical electric currents. Further calculations to test the existence of such currents are being made with the data obtained by the Carnegie Institute in the Pacific, 1905–8, and with the recent resumption of the ocean magnetic work by the *Carnegie* it will soon be possible to make some circuits completely round the earth.

Various types of magnetic disturbances recorded at the five coast and geodetic survey observatories were briefly discussed. An investigation of the relation between solar activity and terrestrial magnetism, carried on in cooperation with Prof. G. E. Hale, showed that the absolute magnetic effect, connected apparently with an *increase* in solar activity, is equivalent in general to a *diminution* in the earth's mean intensity of magnetisation. Between February 1, 1907, and February 1, 1908, this amounted to about 1/1000th part.

The author emphasised the need in such researches of including all the magnetic elements and of differentiating between effects resulting from internal and external magnetic systems.

Mr. R. F. Stupart read a paper on the distribution of pressure over Canada. He pointed out that the world charts of pressure distribution give an inadequate and even inaccurate representation of the pressure conditions in the dominion. He found that relatively high pressure in the north-west at Dawson City is accompanied by relatively mild winters, and low pressure by severe winters, a fact which is directly contrary to the prevailing idea that in winter the higher the pressure the lower the temperature over continental areas. Dr. Shaw read a paper, by Mr. J. I. Craig, on the surface motion of air in certain circular storms. The paths of the air in travelling storms were obtained from theoretical considerations, and compared with the paths found by actual observation.

Mr. J. W. Shipley showed photographs of large hailstones observed in western Canada shortly before the meeting. In the centre of one of the stones he discovered a small fly which had apparently been carried upwards and had formed a nucleus of condensation.

Dr. A. A. Rambaut detailed some of the results of stellar parallax observations carried out at the Radcliffe Observatory, Oxford, with the equatorial instrument acquired about six years ago employing Kapteyn's photographic method. The immediate object of the research was to demonstrate the feasibility of a photographic "Durchmusterung" for parallax extending to stars of the thirteenth and fourteenth magnitude. A paper by Messrs. Plaskett and Harper on two curiously similar spectroscopic binaries concluded the sitting.

On Monday, August 30, the section met in undivided sessions, which began with a discussion on positive electricity, opened by the president of the association, Sir J. J. Thomson. The questions he asked were:—(1) Is there a definite unit of positive electricity? (2) What is its size? The same negative units are obtainable from both oxygen and hydrogen; is the same true for positive electricity? Attention is concentrated on kanalstrahlen and on the motion of positive ions through mixed gases. Sir Joseph Thomson outlined the evidence afforded by the magnetic and electric behaviour of the kanalstrahlen. He concludes that the ratio $e/m$ is the same for the positive rays of all gases and vapours (including uranium chloride) at very low pressures, although at high pressures it does depend upon the nature of the gas, and that therefore there is a positive unit of electricity. This is confirmed by Wellisch's experiments on the velocity of the positive ions through mixed gases; their velocity is the same whether they arise from hydrogen or from methyl-iodide. The value of $e/m$ is of the order of $10^4$; no evidence of smaller particles has been obtained. Some observers, on the other hand, find easily deflected positive rays. It must be remembered that the magnetic field may alter the conditions of the starting of rays, and, secondly, that deflection depends, not only upon $e/m$, but also upon the velocity; the easily deflected rays are probably secondary rays. In the discussion which followed many points were raised dealing with side-issues, but the main question did not receive much fresh elucidation, and in the end the predominant feeling was probably that we are still a long way from obtaining as definite experimental knowledge of positive electricity as we at present possess of negative.

Mr. A. S. Eddington next read a paper on the law of distribution of stellar motions, in which he obtains the constants of Schwarzschild's velocity ellipsoid by making use of the mean proper motions of stars instead of the numbers of stars moving in the various directions as the observed data. The following sufficiently exact result is stated. The radius of the velocity ellipse in the direction

$\theta$ is the geometric mean between the mean P.M. of stars moving in the direction $\theta$ and the mean P.M. of stars moving in the direction $\theta+180$. A paper by Prof. H. T. Barnes dealt with the variation of the specific heat of mercury at high temperatures. Prof. Barnes, employing the continuous-flow method, has now determined the specific heat up to a temperature of 268° C. with an error (for the higher temperatures) of not more than one or two parts per thousand. The results are specially interesting inasmuch as they show that the specific heat of mercury passes through a minimum at about 140° C., and then increases fairly rapidly up to the boiling point. The minimum for water occurs at about the same relative position between the freezing and boiling points. During the discussion on the paper Prof. Perry emphasised the great need there is for an accurate determination of the specific heat of superheated steam. Dr. T. Proctor Hall exhibited an apparatus for making enlarged tracings of sound waves from a cylindrical graphophone record, and showed some of the results obtained with it. Prof. A. W. Porter exhibited some transparencies of electric discharges upon photographic plates. A paper by T. Kinoshita was read in his absence by Prof. Rutherford, on the photographic action of $\alpha$ rays, and Prof. A. S. Eve contributed one on secondary radiation by $\gamma$ rays on different metals. Prof. J. C. McLennan then read one by Mr. W. T. Kennedy, on the active deposits from actinium in uniform electric fields. The deposits were obtained on both of two plates 2 mm. apart, under a field of 250 volts at various atmospheric pressures. As the pressure is decreased from atmospheric the amount of active deposit on both electrodes gradually increases, passes through a maximum value, and then rapidly decreases. The maximum on the kathode is about 2·7 times that for the anode, and is formed at a different pressure. The total deposit is independent of the electric field until potentials higher than the sparking ones are applied. The coefficients of diffusion of the emanation from actinium into $CO_2$, air, and hydrogen are in the proportion 1/1·3/4·2. On Dr. O. Hahn stating that in the case of actinium emanation it is difficult to know what we are dealing with, the reply was elicited that in all probability a number of products are concerned in the experiments described. A paper by Mr. F. W. Bates, on the effect of light on sulphur insulation, was read by Prof. A. S. Eve. The author concludes from some electroscope experiments that sulphur in the presence of light becomes to a slight degree a conductor of electricity to an extent depending upon the intensity of the incident light. In the discussion the resemblance to selenium was pointed out. Dr. Hahn elicited the statement that the effect exhibits no time-lag. Dr. P. Pringsheim mentioned that Röntgen had found a similar effect for paraffin. A paper followed by Dr. T. Franck and Dr. W. Westphal on the charge upon gaseous ions. The authors consider from their experiments that Townsend's doubly charged ions are only a small part of the total ionisation, and that generation in an electric field, contrary to Townsend's view, has nothing to do with their formation. The two kinds can be separated by fractional diffusion if a piece of wire gauze be interposed in their path. The coefficient of diffusion of the double ions is found to be half that of the single ones. With $\alpha$, $\beta$, $\gamma$ rays and point discharge no doubly charged ions were found, though in the last case big charged clusters, due to chemical processes, were proved to occur. A paper on the re-combination of ions in air at different temperatures, by Dr. P. Phillips, was read by the recorder. In the experiments outlined in this paper Langevin's method is adopted. The rays produced by a single discharge in a Röntgen bulb ionise a layer of air between two parallel electrodes, one of which is connected to a Dolezalek electrometer and the other raised to any desired potential. These plates are 3 cm. apart, and the laver of ionised air is 1·5 cm. thick; in these circumstances diffusion is probably negligible. The whole is surrounded by a vapour jacket. The experiment consists in measuring the charges received by the electrometer with different electric fields and temperatures. The following values for $\alpha$, the coefficient of re-combination, were obtained, and are put alongside Prof. Erikson's values recently obtained (*Phil. Mag.*, August) for ions produced by radium :—

| Temperature | $\alpha$ | Erickson |
|---|---|---|
| 15° C. ... ... | 1·00 ... ... | 1·00 |
| 100 ... ... | 0·50 ... ... | 0·51 |
| 155 ... ... | 0·40 ... ... | 0·405 |
| 178 ... ... | 0·36 ... ... | 0·38 (extrapolated). |

The day's session was concluded with a paper by Prof. John Zeleny and Mr. L. A. McKeehan, on the terminal velocity of fall of small spheres in air. Experimenting with spherical spores, the authors find divergences from Stokes's law for the limiting velocity as follows :—

| Substance | Radius | Velocity | Theoretical |
|---|---|---|---|
| Lycoperdon ... | 0·000207 cm. ... | 0·0465 cm./sec. ... | 0 0757 |
| Polytricum ... | 0·000478 ... | 0·228 ... | 0·417 |
| Lycopodium ... | 0·00158 ... | 1·77 ... | 3·52 |

These experiments have an important bearing upon determinations of the numbers of nuclei in cloud condensations. Sir Joseph Larmor attributed the divergences to the inapplicability of the usual theory to particles comparable with the length of the mean free path, and recommended that experiments be made in air of different densities. Prof. Hull agreed that the theory must fail, but expected that the divergences should tend the other way. In answer to Prof. E. W. Brown, it was stated that no Brownian motion or rotation was visible, and the fall was quite steady.

On Tuesday, August 31, the section began with a discussion on earth tides, opened by Prof. A. E. H. Love. Prof. Love stated that Lord Kelvin had shown (1863) that if the earth could be regarded as homogeneous and absolutely incompressible, and possessed of the same degree of rigidity as steel, the oceanic tides of long period would be reduced, owing to the yielding of the earth, to about two-thirds of the theoretical heights which they would have if the substance were absolutely rigid. Sir G. Darwin (1881) estimated the actual height of the fortnightly tide as about two-thirds the theoretical height. Attempts to measure directly the lunar disturbance of gravity were made by several observers; and recently Dr. O. Hecker, by using two horizontal pendulums mounted in an underground chamber, has demonstrated the existence of the corporeal tide, and has shown that the deflection of such pendulums is about two-thirds what it would be if the earth were absolutely rigid. This means that, besides the tide-raising force, F, of the moon, there act on the pendulum other forces arising from the deformation of the earth. These forces are (1) the component of undisturbed gravity tangential to the deformed surface, denoted by $h$F; (2) a genuine disturbance of gravity, consisting in the attraction of the tidal protuberances and other related changes of the attraction of the mass of the earth, denoted by $k$F. The results obtained by Darwin and Hecker, and confirmed by Schweydar, show that the two numbers $h$ and $k$ are connected by the equation $h-k=1/3$. To find $h$ and $k$ separately we must have recourse to hypothesis or to new observations. If we adopt Kelvin's hypothesis we find $k=3h/5$, and thence $h=5/6$, $k=1/2$, and the corresponding estimated height of the corporeal lunar tide is about 46 cm. If, however, we bring in the fact of observation, discovered by Dr. S. C. Chandler, viz. that the period of variation of latitude (about ten months if the earth were absolutely rigid) is actually about fourteen months, we can determine $k$ in terms of known quantities. Variations of latitude imply an adjustment of the earth's figure to rotation about an instantaneous axis which does not quite coincide with a principal axis. The corresponding inequality of "centrifugal force" has the same effect as a certain external force producing a deformation of the earth and a genuine disturbance of gravity. If the force in question is denoted by F, the genuine disturbance may be denoted by $k$F, where the coefficient $k$ is necessarily the same as in the tidal problem. It has been proved independently by Sir J. Larmor and Prof. Love that $k$ is about 4/15. It thence appears that $h=3/5$ approximately, and that the height of the corporeal lunar tide is about 33 cm. The earth would therefore appear to be more rigid than Lord Kelvin estimated it to be, a result confirmed by the interpretation of seismographic records. In the discussion which followed Sir J. Larmor asked whether there was any evidence for Wiechert's theory of the constitution of the earth, viz.

a central metal nucleus surrounded by a viscous layer and an outer shell of rock. On Clairaut's ellipsoidal theory the internal structure is not determinable from outside effects. Observation of the propagation of earthquakes is a direct experiment on the interior; but even here you cannot go far, because of ignorance of the properties of materials under enormous stresses. The phenomena of terrestrial magnetism are also concerned with the interior. He asked how the weight of mountain chains is supported. To avoid crushing, the basal material must have the strength of steel. A rival theory is based on the survey of India, viz. that the mass of a mountain is compensated by less dense material underneath; but Burrard's recent researches show that the defect underneath is not nearly so great as was thought. He pointed out that there was room for a fresh calculation. The presence of a mountain chain supported without collapsing necessitates also that the supporting material shall not have any fluidity at all, or else the mountain chains would gradually settle down. He asked if the necessary calculation had been made. He pointed out that Hecker's curve, being of the right shape though of the wrong size, was in conflict with a supposition of unequal rigidities in different directions. Finally, he propounded a conundrum of Lord Kelvin's: It is possible for any person in this room, if he lived long enough, to turn the earth upside down! Dr. L. A. Bauer directed attention to the semi-diurnal variation of the earth's magnetism, which has so far not been explained. In reference to Wiechert's theory, Prof. Love stated in reply that if it be adopted the rigidities of the supposed metal nucleus and rocky shell required to satisfy the two conditions $h-k=1/3$ and $k=4/15$ are respectively about three times and about one-tenth the rigidity of steel. Attention was also directed to the scooped-out beds of the ocean as being much more important than mountains. More than half the surface is 2000 fathoms below the sea-level. The earth is not an ellipsoid; it is the ocean that is so approximately. At the close of the discussion the section again divided.

In the department of general physics two papers were given by Prof. Poynting:—(1) on the lengthening of loaded wires when twisted; (2) the angular momentum in a beam of polarised light. These have appeared in a recent number of the Royal Society Proceedings. Prof. Frank Allen followed, dealing with the effect on the persistence of vision of fatiguing the eye with red, orange, and yellow. The persistence is measured by finding the speed at which flickering ceases when a sectored disc is rotated in front of a source, and a curve is drawn representing the whole spectrum. This persistence is measured when the eye has been fatigued with light of definite wave-length. When fatigued with light of 680 $\mu$ and 670 $\mu$, only the red part of the curve is affected; fatigued with green only the green part; but when the fatiguing colour lies between 577 $\mu$ and 650 $\mu$, the curves differ in both red and green. With wave-length 660 $\mu$ the two curves coincide completely. This means that the fundamental red sensation is at least beyond wave-length 660, and that yellow and orange cannot be simple primary sensations. Prof. Allen also contributed a paper on a new method of measuring the luminosity of the spectrum. The principle of the method is that the persistence of a colour sensation is a function of the luminosity only. The next paper was by Profs. E. L. Nichols and E. Merritt, on the effect of low temperature on fluorescence spectra. The measurements consisted in comparing the brightness of the fluorescent spectra of natural willemite, commercial anthracene, an alcoholic solution of fluorescein, and one of resorufin at various temperatures from 20° C. to −185° C., these being excited by a quartz-mercury lamp any portion of the spectrum of which, dispersed through quartz, could be focussed upon the fluorescent body. The results were shown by means of curves. In response to a query by Prof. Rutherford, Prof. Nichols stated that the fluorescent bands tend to become narrow as the temperature is diminished. Sir J. Larmor expressed his opinion that fluorescence was due to molecular creeping, but Prof. Nichols replied that though there *is* hysteresis (thermoluminescence), his experiments were all conducted slowly so as to eliminate it. A paper on an analogous subject, the absorption and fluorescence of canary glass at low temperatures, was contributed by Mr. R. C. Gibbs. The glass, of known composition, exhibited a main fluorescence band extending from 0·48 $\mu$ to 0·59 $\mu$. With decreasing temperature the fluorescence for the most part increases, the maximum increase being about 100 per cent. The band, which at ordinary temperature shows a faint indication of two maxima between 0·51 $\mu$ and 0·535 $\mu$, shows at the lowest temperature (−175° C.) two narrow overlapping bands with maxima at 0·514 $\mu$ and 0·533 $\mu$.

In the cosmical physics department, which was sitting simultaneously, Prof. W. J. Humphreys communicated some results he had obtained from a consideration of European *ballons-sondes* observations, while Mr. E. Gold presented the report on the present state of our knowledge of the upper air drawn up by Mr. Harwood and himself. One of the most interesting facts was that both Prof. Humphreys and Mr. Gold found that in areas of high pressure (above 770 mm.) the temperature up to 9–10 km. was greater than in areas of low pressure (below 750 mm.), while at greater heights the conditions became reversed. So long as this condition holds and the isothermal or advective region exists, it appears impossible that there should be anything in the nature of circulatory interchange between cyclones and anticyclones, and the intensity of these systems cannot be maintained.

Gold and Harwood found remarkable minima in the height at which the advective region begins in March and September, and an attempt was made to connect these minima with the general circulation of the atmosphere.

On Wednesday, September 1, the section again bifurcated. In the department of cosmical physics Prof. A. L. Rotch gave an account of the highest balloon ascent in America. He found a remarkable result, which occurred in at least two ascents, that the temperature *increased* in a cumulus cloud in passing from the base upwards. Considerable discussion took place, and doubt was expressed as to the reality of the phenomenon, but Prof. Rotch stated that the observations were unexceptionable. The fact adds further difficulties to the explanation of cloud-formation and its connection with atmospheric motion.

Dr. Shaw showed photographs of models illustrating the temperature distribution in the free atmosphere over the British Isles in the international week in July, 1908. The models show the gradual production or pushing forward of a wedge of cold air at a height greater than 10 km. The wedge had just reached Limerick on the first day, but two days later extended well over England. It may be noted that the construction of the models was only made possible by the observations obtained near Limerick, in Ireland.

Mr. Gold read a paper by Mr. A. Harwood on the results of hourly observations with registering balloons, June 2–3, 1909. At heights above 10 km. there was a diurnal variation of 6° C. to 8° C., with the maximum in the middle of the day, but the values were irregularly distributed, and it was impossible to say how far the variations were real or instrumental.

Prof. W. J. Humphreys described an arrangement for obtaining a record of the ultra-violet part of the solar spectrum (below 0·2 $\mu$) at very great altitudes.

Mr. Stupart read a paper by F. Napier Denison on the connection between atmospheric pressure and the motion of the horizontal pendulum of a Milne seismograph.

Simultaneously, in the department of general physics, a paper was given by Mr. R. F. Earhart on the effect of temperature variations on the luminous discharge in gases for low pressures. The potentials were measured which are required to produce, and also those required to maintain, a luminous discharge for pressures varying from 0·2 mm. to 5 mm., and for temperatures from −78° C. to 325° C. Up to 300° C. Paschen's law holds good for air; for higher temperatures it does not hold even approximately. Prof. Rutherford considered the paper important, because it raises the whole question as to the dependence of ionisation upon temperature. Prof. H. M. MacDonald gave the results of his calculations on the diffraction of electric waves round spherical obstacles. Prof. Love inquired whether the propagation of Marconi waves round the earth could, in the light of these calculations, be attributed simply to the great length of wave employed. Sir J. Larmor reminded the meeting of the

effect of conduction, which probably played a considerable part in the Marconi system. In Lodge's method the antennæ are not earthed, and the result is that much better resonance is obtained. Prof. MacDonald did not think his results would account for Transatlantic transmission, and pointed out that Lodge's method differed also in the use of shorter wave-lengths and antennæ with a much less distance above the surface. In a paper by Dr. T. H. Havelock, on the instantaneous propagation of a disturbance in a dispersive medium, an attempt was made to remove an apparent anomaly in the results obtained by Lord Rayleigh in a recent paper in the *Philosophical Magazine*. A paper followed by C. W. Chamberlain, on the relative motion of the earth and æther and the FitzGerald-Lorentz effect. Analysis shows that the total effect of the relative motion is a displacement of the interfering rays in the line of sight, and one at right angles to it. In the interferometer the former should be detected (in the absence of shrinkage); the latter should not. The author suggested an arrangement, called a diffractometer, which he considered should detect the transverse change. Interference is to be produced between two rays travelling at right angles to one another, and the effect will be analysed by a diffraction grating. A change in the length of the path of one of the interfering systems will produce interference bands either in the spectra to the right or to the left. A shift of a whole band is expected for the length of path used in the Morley-Miller experiments and a grating of 30,000 lines to the inch if the apparatus is rotated through ninety degrees. The failure of many experimentalists to find any effect depending upon the earth's motion through the æther has served so much to strengthen the belief of those who hold that it is undetectable that the meeting seemed inclined to receive the proposal with reserve. Prof. Hull pointed out what he considered a flaw in the reasoning. We must therefore await the results of the actual performance of the experiment or a thorough examination of the calculations upon which the belief in its suitability is based. In a somewhat technical paper Prof. E. W. Brown outlined some new methods under trial for tables of the moon's motion. Lieut.-Colonel J. W. Gifford followed with a description of a new cemented triple devised by him for spectroscopic use, the peculiarity being the possession of a ratio of 7·5 of focal length to effective aperture and great freedom from tertiary colour-aberration. Dr. H. G. Dorsey, in an interesting paper on magneto-striction, said that he finds from experiments on eight steel rods of known composition that the maximum elongation due to magnetisation is a function of the carbon content, the curve being similar to a curve in the iron-carbon phase diagram; there is also a relation between it and the maximum susceptibility of a specimen. The maximum retraction bears an inverse relation to Young's modulus. The results tend to straighten out the somewhat chaotic data obtained by other observers. One more paper now remained on the programme, but the inexorable clock pointed out that the time had arrived for the compulsory closing of the sessions. So the final rites were performed, and then an interested group informally examined some remarkable vibration curves of speech exhibited by Prof. D. C. Miller.

## *CHEMISTRY AT THE BRITISH ASSOCIATION.*

BEARING in mind the special local conditions attaching to a meeting of the association out of England, the work of the section was organised so as to include the consideration of broad problems of general and local interest rather than the reading of specialised papers. Accordingly, the section sat jointly with the physicists for one session, with the physiologists and agriculturists for another, and with the botanists and agriculturists for a third. These joint discussions were all exceedingly successful and attracted large audiences.

It was regretted that a larger number of the younger English chemists did not make the journey to Canada, and still more that so few of the chemists from eastern Canada were present, though the section was particularly indebted to Mr. F. T. Shutt, of Ottawa, for his contributions to the discussions. The section was strengthened by the presence of a number of American guests, in particular Prof. W. A. Noyes, Prof. G. B. Frankforter, and Dr. A. Springer.

Stress was laid throughout the meeting on the importance and necessity of Winnipeg and the province of Manitoba possessing a university fully up-to-date in every respect. In particular, attention should be devoted in Winnipeg to agricultural chemical research and to the higher training of agriculturists. Wheat must always be a pioneer crop, as it requires less capital, less labour, and less skill than most other types of farming. With fuller development or with some change in the world's requirements a change will come in the farming, and wheat may become a by-product, as often in England now. Such a change comes very quickly, and the farmer will go under unless he is prepared for it and has the highest scientific advice.

In the United States the farmer has realised very definitely the benefits he has obtained by following the results of the experimental stations; in consequence he supports the State universities, and has the greatest belief in the schools. On the western excursion there was abundant opportunity of remarking that the Canadian is equally far-sighted in regard to the schools, but it is none the less necessary to urge that the university work, and above all university research, be not neglected.

Following the president's address, which was delivered at such an hour that members of the section could also attend the addresses delivered by the presidents of Sections A and G, the work of the section was opened by a short paper from Prof. W. A. Noyes dealing with his recent work in connection with camphor. A very full report on combustion, by Prof. W. A. Bone, was taken as read. Prof. E. H. Archibald outlined the method followed by him in a new determination of the atomic weight of iridium. Potassium chloroiridate was analysed by weighing the dry salt, reducing it in hydrogen, and estimating the hydrochloric acid formed, the potassium chloride and the metallic iridium set free. The results show a value of 192·9 for the atomic weight. His further paper, contributed jointly with Mr. W. A. Patrick, dealt with the electrical conductivity of solutions of iodine and platinum tetraiodide in ethyl alcohol. The conductivity of solutions of iodine in ethyl alcohol increases rapidly with time, reaching a maximum in about twenty-five hours at 25°. Platinum tetraiodide forms good conducting solutions with alcohol.

A paper of very considerable interest, on the anti-putrescent effects of copper salts, in particular towards the bacteria of milk, was contributed by Dr. Alfred Springer. Copper salts are selective in their action, greatly retarding or inhibiting the putrefactive bacteria such as *Proteus vulgaris, P. mirabilis, P. Zenkeri,* and *Clostridium foetidum,* but having little effect on the lactic bacteria. Consequently, milk treated with copper salts retains its sweet odour even when the acidity becomes sufficiently high to curd it. On the other hand, moulds such as *Penicillium glaucum, Aspergillus niger, Eurotium repens,* and others, grow more freely on milk containing copper salts, probably because they are left a freer field for development. The origin of small traces of copper in the milk supplied by a Cincinnati firm was traced to contamination of the sterilising cloths, pails and other utensils with the boiler compound used to soften the water. Copper salts have an anti-putrescent effect on blood albumen, egg albumen, meat, milk and sewage solutions.

The report of the committee for the study of hydro-aromatic substances (secretary, Prof. A. W. Crossley, F.R.S.) describes the preparation of nitro-derivatives of *o*-xylene and the synthesis of *iso*phorone.

The transformation of aromatic nitroamines committee (secretary, Prof. K. J. P. Orton) summarises the results obtained by the study of the transformation of chloro-aminobenzene into nitroaniline.

The report of the isomorphous benzene sulphonic acid derivatives committee (secretary, Prof. H. E. Armstrong, F.R.S.) contains the crystallographic data of a number of *para*-dihalogen derivatives of benzene; these afford confirmation of Barlow and Pope's conclusion as to the existence of columns of carbon spheres in crystalline benzene

derivatives, and support the confirmation previously obtained by Jerusalem by the study of the picrates and styphnates.

The electro-analysis committee (secretary, Dr. F. M. Perkin) reported on experiments upon a new design of potentiometer, on the general simplification of the apparatus, on a method for the electro-deposition of metals by means of graded potential, and in connection with the electro-deposition of mercury upon gold, silver, platinum and mercury kathodes.

A joint meeting with the general physics department of Section A took place on Friday, August 27. A large attendance was attracted, and the communications were discussed by members of both sections. Only the more purely chemical papers are noted in the following. Dr. T. M. Lowry presented the report of the committee on dynamic isomerism in the form of a general discussion on dynamic isomerism in relation to luminous phenomena. Attention was in the first place directed to the decisive evidence adduced that the presence or absence of a band in the absorption spectra of a camphor derivative is in no way dependent on the occurrence or non-occurrence of isomeric change. Certain luminous phenomena, *e.g.* mutarotation and phosphorescence, have been shown to be manifest only in presence of a catalyst, and not when pure materials are used; they are therefore dependent on chemical change. Refraction, dispersion, and optical rotatory power do not appear to be dependent on the presence of foreign substances, and are to be referred to physical characteristics of the molecule. Colour, fluorescence, and triboluminescence are still subjects of controversy. The last two are probably dependent on chemical structure, but it is difficult to resist the conclusion that colour is an essentially physical phenomenon in which chemical change plays no essential part. The conclusion is one which is confirmed by the study of crystallisation in relation to phenomena.

This paper provoked considerable discussion. Sir J. Larmor remarked that phosphorescence is due, not to the formation of ions, but to complex molecules forming and breaking up, and instanced that iodine vapour, which is strongly phosphorescent, shows no conductivity, and therefore contains no ions.

In three further notes Dr. Lowry put on record some useful improvements in the technique of optical investigations. Measurements of rotatory dispersion have been made with light of twenty-six different wave-lengths, and the green mercury line Hg 5461 has been selected as the principal standard in place of the sodium doublet on account of its brilliance and purity.

The optical and magnetic dispersions produced by quartz are identical, but optically active liquids have the optical dispersion usually, though not always, higher than the magnetic dispersion. It is suggested that the magnetic rotatory power of liquids depends upon a spiral packing of the molecules of the same general character as that which produces the optical rotatory power of quartz.

To produce a cadmium spectrum of sufficient intensity for polarimetric work, use is made of the silver cadmium alloys; these have high melting points, and give a steady arc which can be kept true to centre by rotating the electrodes in opposite directions. The silver and cadmium lines are so far separated that no overlapping takes place even when the spectroscope slit is opened to its full width. Mercury and cadmium lines are suggested as standards in refractometry.

Two papers by Dr. C. J. J. Fox were taken as read. The constancy of the hydrogen-gas electrode in sulphuric and hydrochloric acids has been investigated when gold or platinum coated with either platinum or palladium black are employed; in a very few minutes values concordant to less than 0·05 of a millivolt were obtained. Palladium coated with palladium black gave a value 4 to 5 millivolts too high. A new method of preparing trustworthy mercurous sulphate for standard cells is described; this consists in heating commercially pure mercurous sulphate for a day or so at 120°–150° in a sealed tube with a little mercury and dilute sulphuric acid. The sulphate is thus obtained free from nitrate and basic sulphate.

The joint discussion with the botanists and agriculturists on wheat and flour had been carefully organised previous to the meeting, so that the contributions might be made in logical sequence and present as full a picture as possible of the exact position of our present knowledge of wheat and flour from every point of view. The present problems are quite clear; the chemist has to map out the wheat soils and to watch the quality of the product; the botanist has to breed wheats that suit local requirements and command a good price in the market.

The subject was particularly appropriate for discussion at Winnipeg, and the discussion, which throughout was very technical in character, was closely followed by an expert audience. The first paper, by Dr. Stapf, on the history of the wheats, dealt with their classification and characteristics. The great economic importance of the wheats proper lies in the fact that the looseness of the grain in the husk enables threshing to be quickly and cheaply accomplished. Dr. E. J. Russell followed with a paper by A. D. Hall and himself on the factors determining the yield of wheat, based on the experiences at the Rothamsted Station since 1851. The chief elements of nutrition derived from the soil or manure are nitrogen, phosphoric acid, and potash; other elements also play their part, but are supplied in sufficient quantity by all ordinary soils. The yield of grain is proportional to the nitrogen supplied, but two sets of factors may be traced in the results. At first the root system of the plant increases with the supply of nitrogen, and the yield is more than proportional to the supply; subsequently other limiting factors come into play, and the increase is smaller for the third and fourth increments of nitrogen.

Wheat does not require large quantities of phosphoric acid; the effects of this manure are secondary, and dependent upon season. A deficiency of potash is shown by a reduced yield, especially in dry seasons, and by increased tendency to disease, rust, &c.

Wheat is one of the crops best adapted to dry regions. High temperatures are not necessary excepting at the time of maturation. The type of soil in relation to climate is a very important factor. To each type there is a limiting yield, beyond which the crop will not go. This limit is not the same for all varieties of wheat.

Mr. F. T. Shutt, chemist to the Dominion Experimental Station, Ottawa, followed with an account of the influence of environment on the composition of wheat. The factors which might be supposed to influence composition are heredity, environment and soil. Soil, however, has very little effect on the composition, as distinct from the yield, of wheat. The shorter the period which elapses from the formation of the kernel until it is ripe the higher the nitrogen content. High temperatures, long days, and absence of excessive moisture during the ripening process hasten the maturation of the grain and increase the percentage of gluten. These are the conditions which prevail in the Canadian North-west.

Experiments were described in which the same wheat was grown on old land and recently cleared land, the older land being the drier and yielding wheat with a higher percentage of protein. It is suggested that the quality of the wheat as measured by the quantity of gluten it contains is dependent on the amount of soil moisture during development and ripening of the grain. The quality of the gluten, however, is considered to be controlled by heredity.

The subject was next developed from the point of view of the miller, a paper by Mr. A. E. Humphries being read by the recorder of the section. This dealt with the vexed question of quality in wheaten flour. Good quality is the sum of excellence on several points, and is technically denoted by the term "strength." Strength is defined as the capacity for making large, shapely, and therefore well aërated loaves. This is a very complex conception, and it is now admitted that at least five separate considerations are included in the term quality; these are (1) flavour; (2) colour; (3) stability of dough; (4) size and shape of loaf; (5) yield of bread per sack of flour. A pleasant flavour is an essential, but the exact flavour desired is chiefly influenced by fashion. Colour in bread is largely a question of optics, a strong flour making a whiter loaf than a weaker flour. A large loaf indicates a high gas-making capacity and a high diastatic power,

but this is not a true index of strength. It is the gas evolved in the later stages of panary fermentation which is of importance, and the gas-retaining power of the dough which is the most important factor in strength. This is apparently a function of the quality of the gluten, and dependent on the proportions of various acids and salts which affect the physical properties of the gluten.

Dr. E. F. Armstrong followed with some notes on the chemical properties of flour and an account of the recent work on strength. Flour is composed of (1) starch; (2) several kinds of proteins; (3) mineral matters present only in small quantity; (4) a little sugar; (5) a little fat; (6) moisture; (7) enzymes. It has been the object of the chemist to seek to correlate the chemical properties with baking qualities. Most attention has always been paid to the gluten of flour; generally the strongest flours have the most gluten, but this test is not absolute. Attention has further been directed to measuring the quality of the gluten either by physical or chemical means, such as the amount of water it will retain or the proportion of gliadin in it. The total nitrogen of a flour is another rough indication of quality; latterly the distribution of nitrogen in its various forms has also been studied. To make a light loaf the flour must be one which will give rise to sufficient gas during fermentation; it must contain enough diastatic enzyme or have its starch in a form which is easily attacked. Whymper has found that the largest starch grains are those first attacked by enzymes, and it appears that different flours contain different proportions of large starch grains. The mineral matters and enzymes of flour are likewise of the very greatest importance in affecting quality.

Mr. W. B. Hardy, who followed, dealt with the influence of the minerals of flour on its quality. Gluten owes its tenacity and elasticity to the presence of salts and acids in certain proportions, pure gluten having no tenacity.

Prof. R. Harcourt, of Guelph, directed attention to the comparative milling and baking qualities of a number of Canadian wheats. Though the Manitoba spring wheats do not contain more gluten than the Alberta winter red wheats, they give a better yield of bread and a larger loaf. Blends of Alberta red with soft Ontario winter wheats give a flour superior to either of the constituent flours baked singly. This confirms the common practice of English millers. The discussion then turned to the breeding of wheats. Dr. C. Saunders gave a most valuable account of wheat-breeding experiments in Canada, and a highly suggestive paper on the influence of good seed on wheat production was read by Prof. C. A. Zavitz. A paper by Prof. L. S. Klink dealt with individuality in plants. A general discussion of great interest followed, and it was subsequently agreed by the general committee that the discussion be printed in full in the report of the meeting.

Tuesday, August 31, was devoted to a joint meeting with the representatives of physiology and agricultural chemistry to consider the subject of "food." The views developed were of the very greatest importance, more especially as indicating the lines on which future work in this field should proceed. After some introductory remarks by the chairman, a paper on "Proteins: the relation between composition and food value," was read by Dr. E. Frankland Armstrong. The quotient of the amount of nitrogen in a food material multiplied by the factor 6¼ is commonly spoken of as protein without any reference to its nature, although it has long been realised that proteins of different origin are not the same. The proteins have been proved in the main to be built up of amino-acids, belonging both to the aliphatic and aromatic series, or derived from cycloids containing nitrogen, of oxyamino-acids, and of diamino-acids. In different proteins these structural units are present in varying proportions, and, since the amino-acids are very different from one another in their chemical structure, it must be supposed that they each fulfil somewhat different functions in building up the tissues of the body. It thus becomes important to see that each is supplied in the proper proportions required by the body. Further, the analytical results point to the impossibility of entirely replacing a diet composed of one kind of protein—for example, meat—by another diet composed, let us say, of nuts, since the two proteins, though made up of the same structural units, contain these in entirely different proportions.

It remains to solve such problems as the precise function and significance of each amino-acid in metabolism, how far they may replace one another or be absent altogether without injurious effects; further, to what extent each is concerned in the maintenance of a particular tissue. Probably the presence of most, if not all, of them is necessary in a food if health is to be maintained. Tryptophane, for example, has been shown to be essential by Willcock and Hopkins. The ideal diet should contain as much variety of protein as possible in order to provide sufficient of all the possible units of constructive metabolism.

Prof. Starling, F.R.S., suggested that it was possible to attach too much importance to protein as a mere source of nitrogen. In reality, four-fifths of the protein of food is not connected with the nitrogen question. Proteins may decompose in two ways; in the one nitrogen is immediately eliminated, and a residue produced which contains as much energy as the fats or carbohydrates, and furnishes this energy on oxidation. Only a small amount of the protein is built up into the body. A protein diet is never stored as fat, neither is the above-mentioned carbonaceous residue stored as fat. A protein meal is followed by a large output of carbon dioxide and intake of oxygen, the residue being more easily oxidised than the original protein. The value of proteins as a food is due to this, and it is important that the fate of the residue in the body should be investigated.

Proteins also undergo decomposition in another manner, namely, the carboxyl group is eliminated and amines are formed. These amines have a marked physiological action; for example, those from tyrosine and phenylalanine have an action like that of adrenalin. A big meat-eater usually has a high blood pressure, whilst the constant formation of such amines causes the various disorders of middle age.

Dr. E. J. Russell, of the Rothamsted Experiment Station, next dealt with the problems of the stock feeder, who asks for methods by which he can determine the relative food value of various agricultural products. Experience has shown that animals fed on barley meal or cotton cake singly do not do so well as those fed on a mixed diet of both ingredients. A single food is not enough, but it is not known what the ideal mixture should be. Swedes grown on chalk loam have not the same feeding value as those grown on sand. There is a similar difference in the value of grasses grown under substantially the same conditions. Fibre is of very little value as a food—it acts merely to distend the stomach. The mineral constituents are of great importance, and may account for some of the facts recorded. Pigs fed on maize give a low-grade bacon; a diet of maize and minerals gives a better bacon; and the best article is obtained by feeding with barley meal. The food has an effect on the character of the beef and on the production of milk. Cotton cake, for instance, causes the production of milk, whereas with linseed cake the cows lay on flesh instead of producing milk. Prof. Cushny, F.R.S., alluded to the influence of taste and the importance of the mineral constituents.

Mr. F. T. Shutt described some experiments on pig-feeding. The Canadian pork was originally found to be too soft for the packers owing to the quality of the fat. This was got over by the addition of skim milk, which, together with corn, was found to afford an ideal diet. An increase in the proportion of corn softens the fat; too much actually kills the pigs. The fat of the animal and of the cereal is stated to be the same.

Dr. F. N. Alcock alluded to the changes in the habits of the women of the upper middle classes during the last fifty years. Their diet to-day contains less protein and less malted liquors, and this is probably to be associated with the fact that they no longer have large families or are able to nurse their offspring. Infants commonly get too little protein, which necessitates that they receive only a minimum quantity of some—probably essential—residue.

Prof. J. Wilson indicated in historical sequence the views which had in turn prevailed on the feeding of stock. In early days the cattle practically starved during the winter on a large amount of straw, and had no energy left in the spring. A great improvement was experienced

about the middle of the eighteenth century, when turnips were added to the diet, and the introduction of oil cake about 1797 made it possible to fatten during the winter. It is found that a linseed-cake feed gives the results most desired by the butcher, a cotton-cake feed giving a poorer bullock. The oil was long considered to be the valuable constituent; later, most importance was attached to the albumenoids. Maize was introduced in 1875, brewers' grains a few years later, and the carbohydrates are now regarded as a most important constituent.

In the subsequent discussion the minimal protein was defined as that sufficient to supply the units for tissue formation. Dr. E. F. Armstrong alluded to the importance of the mineral constituents in a colloidal state and their analogy to enzymes. Prof. Starling pointed out that the physiologists diet for health, whereas the agriculturists feed for fattening purposes.

## *ANTHROPOLOGY AT THE BRITISH ASSOCIATION.*

THE meeting of Section H at Winnipeg, apart from being one of the most enjoyable of recent years, was also fruitful of much good work, and was undoubtedly in every respect a great success. It was hardly to be expected that the audiences would be as large as at an English meeting, but although the numbers attending the section were at first few, they increased daily, and at the end were well up to the average. Last year a great diminution in the number of papers dealing with physical anthropology had to be recorded. Unfortunately, this was still more apparent at Winnipeg, and only one paper on the subject was presented. It is to be hoped that this is only a temporary falling off, and that in future years the papers on physical subjects will be as numerous as in the past.

The address of the president, Prof. J. L. Myres, on "The Influence of Anthropology on the Course of Political Science," need only be mentioned here, as it has already appeared in the pages of NATURE. The last few paragraphs of it, however, in which the president urged the importance and necessity of undertaking an ethnographic survey of Canada, must have particular attention directed to them, as, in a way, they struck the keynote of the meeting.

When the association met at Montreal in 1884 Prof. Tylor presided over the newly formed anthropological section, and the chief result of the meeting was the foundation of an ethnographic survey of Canada, under the auspices of the association, which appointed a committee and gave liberal grants. This committee did much good work and published annual reports, but the lamented death of Dr. George Dawson brought work to a standstill. Since then, with the notable exception of Mr. Hill-Tout's work on the Salish of British Columbia, practically nothing has been done by Canadians towards a systematic study of the natives inhabiting the Dominion. It was felt, therefore, that the time was ripe for endeavouring to organise an ethnographic survey, and a whole day was accordingly set apart for papers and discussion on this important subject.

This discussion was opened by Mr. Sidney Hartland, who gave a *résumé* of the work that had been done in the past from the times of the Jesuit fathers onwards. This retrospect made it apparent how small had been the part taken by Canadians in contributing to our knowledge of the natives of the Dominion, and how little interest had been taken by the Dominion and provincial Governments, which had been content to leave inquiries, which have a bearing, not only on scientific questions, but also on the practical problems of government, to the Government and museums of the United States, and to individual effort.

Mr. Hartland was followed by Dr. Franz Boas, of New York, who, in a paper on the ethnological problems of Canada, urged the immediate importance of undertaking such a survey at once, before it is too late. Primitive life is rapidly disappearing before the economic progress of Canada, and unless the work is undertaken at once the opportunity will be gone for ever, and information which will have a most important bearing upon general anthropological problems will never be obtained. Dr. Boas then directed attention to some of the problems awaiting solution, and pointed out what an important field Canada offered to the investigator.

Dr. G. B. Gordon, of the Philadelphia Museum, explained the work which is being undertaken by the Smithsonian Institution and the various museums in the United States.

But the native question, although the most pressing, is not the only ethnographic problem in Canada which requires study. The problem of the white immigrants is in many respects even more important, and a strong feature was therefore made of this side of the question. Dr. Shrubsall, who opened the discussion on this aspect of the problem, pointed out the great importance of collecting careful statistics so as to be able to ascertain the effect of Canadian environment upon immigrants of European origin. He urged the vital importance of a survey of physical characters, mental conditions, and physique, so as to discover what type was best suited to the Canadian environment, and he also pointed out how necessary it was that the Dominion should take preventative measures now to stop the landing of the physically or mentally unfit, rather than remedial measures later. The task before the Dominion was to prevent these problems, which are now facing the great centres of population, from arising in Canada rather than to let them arise and then to attempt to remedy them.

As a result of this discussion a committee was appointed by the association to consider what steps can be taken to organise an ethnographic survey of Canada, and a memorial has also been drafted urging upon the Government the importance of undertaking the work before it is too late. It is hoped that this memorial will be presented in due course.

As was natural at a meeting in Canada, many papers dealing with American, and particularly Canadian, ethnology and archæology were presented to the section.

To take first of all those dealing with Canadian ethnology. Mr. Hill-Tout, whose reports on the various British Columbian tribes have appeared from time to time in the Journal of the Royal Anthropological Institute, presented a further instalment of his work in a report on the ethnology of the Okanagan of British Columbia. These people are the most easterly division of the Salish of the province, but they are not confined to British Columbia, but extend southwards into the United States, the international boundary dividing them into two fairly equal divisions. The material culture and language of the stock was discussed, and from the linguistic and cultural evidence a most important conclusion was arrived at, namely, that the original home of the stock, before its division into its present sections, was not the rivers and bays of the Pacific coast. The staple food of these people is now, and as long as they lived where they do now must have been, the salmon. If, therefore, they had inhabited their present districts before their language was divided into its present groupings, we would expect to find the same word for salmon among the different stocks; but this is not the case, and, in addition, their myths as to the origin of the salmon differ. It seems clear, therefore, that, before the division, the people cannot have inhabited their present district. Where they came from is another matter, but it is noticeable that the linguistic evidence points to a connection with Oceanic stocks.

An interesting paper on the Blackfoot Medical Priesthood was presented by Dr. John Maclean. The paper dealt with every aspect of the subject, with the initiation ceremonies, dress, and facial decoration, and with the causes of disease, especially the influence exerted on the mind and body of the native by his belief in evil spirits. Native medicines and remedies were also discussed, and the value of the work of the medicine-men among the natives and the influence exercised by them on the native religion.

Mr. William McIntosh presented a paper on the present native population and traces of early civilisation in the Province of New Brunswick. At the present time the native and half-breed population numbers about 1500, and is composed of two tribes, the Micmacs, on the east coast and part of the shores of the Bay of Fundy, and the Malecites, on the St. John River valley, which is approximately the site of their ancient habitations. There are abundant traces of the prehistoric occupation of the

district by peoples in the Stone age of culture. Kitchen middens and camp sites are abundant; stone implements, almost invariably of the type common to the Algonquin areas, are numerous, while there is a considerable amount of pottery which in material and shape closely resembles Algonquin wares, but shows interesting varieties of ornamentation.

An interesting series of copper implements from a site in western Ontario was exhibited by Prof. E. Guthrie Perry. The collection consisted of a large number of fish-hooks and of spear- and arrow-heads. All were of cold-hammered copper from the Lake Michigan district.

In a paper on the archæology of Ontario and Manitoba, Prof. H. Montgomery, who has spent many years in excavating mounds and other early sites in America, gave a general account of his work on the antiquities in this part of Canada, and exhibited many of the objects discovered.

Miss A. Breton presented a paper on race types in the ancient sculptures and paintings of Mexico and Central America. There is an enormous mass of material available for study, including terra-cotta or clay statuettes, small jadeite heads and figures, archaic stone statuettes, portrait statues and reliefs, stelæ, MS. frescoes and vases. Among distinctive types are the chiefs on the reliefs at Xochicales, the shaven clay heads at Teotihuacan, the priests, with protruding lower lip, of the Palenque reliefs, the caryatid statues, in feather mantles, at Chichen Itza, and the sixteen warriors, at the same place, of a type similar to some of the modern Indians of the villages near Tlaxcala. Portraits of the Mexican kings are on the border of a picture map, representing the western quarter of the town of Tenochtitlan. Of female types there are the painted clay figures of Jalises with compressed heads. The figures of some of these are short and broad, while others are slender, and it is interesting to note that the type still survives. Finally, on the Guatemalan stelæ two female types are shown, the women-chiefs being obviously of a different caste to the victims prepared for sacrifice.

In another paper Miss Breton described the arms and accoutrements of the ancient warriors at Chichen Itza, where the walls of the Temple of the Tigers are covered with sculptured rows of chiefs, carrying a variety of weapons. Among these are stone implements, harpoons, spears, and the throwing stick. For defensive armour the warriors wear protective sleeves in a series of puffs, breast plates and helmets, and carry round or oblong shields.

Dr. G. B. Gordon gave an account of his recent expedition to Alaska on behalf of the University of Pennsylvania. The tribes investigated were those inhabiting the Koskokwim valley, who preserve to a marked degree their aboriginal characteristics. In the upper valley were found Dené tribes preserving the characteristics of the Dené stock. Seven hundred miles from the mouth of the river Eskimo culture began, and two hundred miles further Eskimo culture had entirely replaced the native customs, even in those communities where there was little or no admixture of Eskimo blood. The tendency of the Dené in this region to adopt Eskimo culture, which has intruded from the Bering Sea district, is most marked, and shows the aggressive nature of the Eskimo civilisation. At the mouth of the river the Eskimo have retained in full vigour their peculiar customs and mode of life, because that part of the coast has not been visited by trading vessels or whalers.

As is usual at meetings of the section, papers dealing with Mediterranean archæology and with the work of the British Schools at Athens and Rome were again a prominent feature.

In a paper on recent Hittite research, Mr. D. G. Hogarth gave a most valuable *résumé* of the present state of our knowledge of this interesting subject, and summarised the results of the explorations which have taken place. At first the general opinion was that the Hittite race and civilisation were Syrian, but gradually opinion has changed, and it is now held that the original home of the Hittites must be looked for in Cappadocia, and that only at a later period were they domiciled south of the Taurus. At Boghaz Koi has been discovered what amounts to the collection of royal archives, among them a duplicate of the treaty between Rameses II and Khetasar, inscribed on the wall of Karnak; this discovery shows that Boghaz Koi was the centre of the Hittite confederacy as early as 1280 B.C., and proves that the Hittite power was centred in north-west Cappadocia long before it is mentioned as being at Carchemish by the Assyrian records.

In their paper on prehistoric antiquities of Malta, Dr. Ashby and Mr. Peet, of the British School at Rome, described the excavations on the Corradino Hill, now being conducted by the Maltese Government with the active cooperation of the British School at Rome. The excavation of the rock-cut hypogeum at Halsaflieni shows that its architectural features imitate in a most surprising way the sanctuaries above ground, and it has, moreover, produced an adequate series of Maltese pottery of the Neolithic period. Excavation has shown that the Megalithic buildings on the Corradino Hill are of irregular plan. They were constructed of rough masonry, with large slabs at the bottom and smaller ones higher up. The walls converge as if to form a roof. The use of standing slabs at the base of the walls, with coursed masonry above, is paralleled by the giants' tombs in Sardinia and the prehistoric huts of Lampedusa.

In the report of the committee appointed to carry out archæological and ethnological researches in Sardinia, Dr. Duncan Mackenzie showed that the tombs of giants were the burial places of the dwellers in the Nuraghi, and that these tombs, with their elongated chamber and crescent-shaped front, were derived from the more ancient dolmen type. In one case the chamber of an original dolmen tomb had been elongated so as to resemble a giant's tomb. In another example the large covering slab was supported by upright slabs at the sides and back, and behind are traces of an apse-like enclosing wall, a characteristic of some of the dolmens of northern Corsica and Ireland, where giants' tombs do not exist. A new type of giant's tomb was also discovered in which the mound was entirely faced with stone, upright slabs being used below and polygonal work above. Another feature, hitherto unique, is the discovery of a hidden entrance into the chamber on one side in addition to the usual small hole in front, through which offerings were probably introduced.

The work of the British School at Athens on the site of the shrine of Artemis Orthia at Sparta was fully described by Mr. R. M. Dawkins, the director of the school. At previous meetings of the association the work of excavation for the past year has been described in detail, but in this paper Mr. Dawkins gave a general *résumé* of the work on this interesting and important site.

Two other important contributions to Mediterranean anthropology were the reports of the committees to conduct researches in Crete and on Neolithic sites in Thessaly. The former committee issued an interim report by Mr. C. H. Hawes, who has been conducting somatological investigations. He reported the discovery of human remains certainly not later than Middle Minoan I. These remains consisted of four skulls, two portions of other crania, and several pelvic and long bones. All were in a wonderful state of preservation, and it is hoped that complete measurements will be published at an early date. Mr. Hawes has also been investigating the craniology of the modern population of the island with the view of comparison with that of the ancient population, and it is expected that most important results will be obtained from this investigation.

The work of excavating Neolithic sites in Thessaly has been continued during the past year, and it is now quite clear that there existed, in this isolated part of Greece, a people who were unaffected, until a comparatively late period, by the bronze culture around them, and who remained in the Stone age almost until the beginning of the age of Iron. It is important, too, to note that an analogous state of culture has been discovered in similar latitudes in southern Italy.

A paper on excavations at the Nubian cemetery at Anibeh was presented by Dr. Randall-MacIver. The cemetery, which dates during the first five centuries A.D., exhibits a culture, apparently of negro origin, but strongly influenced by Egyptian, Greek, and Roman art. A most important feature was the discovery of a form of script which has not up to the present been deciphered.

Other papers which call for passing mention are one by Mr. Sidney Hartland, on a cult of executed criminals in Sicily; another, by Mr. W. H. S. Jones, on a study of malaria in ancient Italy, which will shortly be published in the Liverpool Annals of Archæology and Anthropology; and one by Dr. Shrubsall, on the influence of geographical factors on the distribution of racial types in Africa, in which he showed that the trend of the migrations was from the north southwards, and also directed attention to the importance in the problem of the presence of the tsetse-fly in certain areas, which, by modifying the conditions of animal life in those districts, influenced their occupation by the native population.

Among the reports of the various research committees special attention should be directed to that on stone circles, which reported that excavations had been continued at Avebury, with the result that additional evidence had been collected which tended to confirm the opinion, arrived at in the course of the previous year's excavations, that the monument was of Neolithic date.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Colonel Sir T. H. Holdich, K.C.M.G., will deliver a lecture on Thursday, October 21, on some aspects of political geography. The lecture will be given in the large lecture-room of the Sedgwick Museum of Geology. Lieut. Shackleton will lecture on Thursday, October 28. The lecture will be given in the examination hall.

Dr. Breul, the reader in Germanic, will conduct practical exercises in reading scientific German for students of natural science at the literary lecture-rooms on Tuesdays and Thursdays, beginning on Thursday, October 14.

LONDON.—University College:—A course of lectures in electrochemistry will be begun by Dr. Wilsmore on Monday, October 18. The lectures on vertebrate palæontology, by Prof. J. P. Hill and Dr. Woodland, began on Tuesday last. It is announced that Dr. Woodland will deal with fishes in the first term, and Prof. Hill with Amphibia, Sauropsida, and Mammalia in the second and third terms.

OXFORD.—Mr. Walter Brudenell Gill, formerly scholar of Christ Church, has been elected to a fellowship at Merton College to undertake research work in physics, and to act as a demonstrator in one of the laboratories of the University.

Dr. G. B. Longstaff, of New College, has, through the trustees of the endowment fund, presented the sum of 2400*l.* to be invested as an additional endowment for the Hope Department of Zoology. A decree will be introduced in Convocation on October 26 to record the gratitude of the University for the gift, and to sanction regulations for the employment of the fund. The regulations contemplate the endowment of an assistantship to the Hope professor of zoology, but the curators of the Hope collections are empowered to make other arrangements with the sanction of the donor.

MISS ALICE PARKIN has been appointed organising secretary for the courses in home science and economics at King's College, London, for Women.

A SPECIAL course of lectures by Mr. A. P. Thurston on aëronautics is announced by the East London College, Mile End Road. The first lecture will be given on Monday, October 18.

A LAKH of dollars (8750*l.*) has been collected in the Canton district, and forwarded to the Governor of Hong Kong, as a contribution towards the endowment fund of the Hong Kong University.

IN addition to the men of science referred to on p. 419 of NATURE (September 30), the Bohemian University of Prague has conferred the honorary degree of Doctor of Philosophy upon the following:—Prof. H. B. Dixon, F.R.S., Prof. J. Burnett, and Prof. W. R. Morfill.

THE Ottawa correspondent of the *Times* states that Mr. Andrew Carnegie has given 20,000*l.* to the general funds of the McGill University, Montreal. The offer was made upon the condition that 100,000*l.* should be raised from other sources, and this has been done largely through the generosity of Lord Strathcona.

AT the inauguration of Dr. A. L. Lowell as president of Harvard University on October 6, the honorary degree of Doctor of Letters was conferred upon the Right Hon. James Bryce, the British Ambassador to the United States, and the following representatives of British universities:—Prof. W. A. Herdman, F.R.S., Dr. W. N. Shaw, F.R.S., Dr. G. A. Gibson, Prof. J. Biles, and Mr. J. Willis Clark.

THE opening meeting of the autumn session of the Eugenics Education Society was held last week in the Caxton Hall, Westminster, when Lieut.-Colonel C. H. Melville delivered a lecture on eugenics and military service, in the course of which he stated that one of the objects of eugenics was to improve the individuals of the present generation. He contended that military service, by strengthening character, was a positive benefit to the individual, who was physically improved by better food and housing, while moral advantages accrued from discipline and association with comrades.

THE Board of Education has published (Cd. 4875) the fifteenth volume of reports from the universities and university colleges which participated in the year 1907–8 in the annual grant, now amounting to 100,000*l.*, made by Parliament for "University Colleges in Great Britain," and from the three colleges in Wales which received a grant of 4000*l.* each. For the first time a report is included from the London School of Economics, which was in 1907 awarded a grant of 1150*l.* The individual reports are exhaustive and full of information on every matter of importance in connection with higher education in the districts served by the participating institutions; but the value of the bulky Blue-book to students of educational administration is impaired seriously because nothing is attempted by the Board of Education in the direction of summarising the scattered information, or of tabulating the facts concerning the various colleges, so that it may be possible rapidly to compare, say, the local support for higher education in various parts of the country, the cost of such education per head in different districts, and so on. The attention of the Board may be directed to similar reports issued by the U.S. Bureau at Washington, in which reference and comparison is made easy for the student.

AN examination of the calendars of the newer universities shows how completely their governing bodies realise the importance of providing, in addition to the more ordinary courses of academic training in arts, pure science, medicine, and law, lectures and laboratory and workshop practice in the higher branches of technology of special importance in the districts in which their universities are located. The current calendar of the University of Leeds, for instance, shows that its students may attend technological courses, and, if they so elect, graduate in, civil and mechanical engineering, electrical engineering, mining, gas engineering, fuel and metallurgy, applied chemistry—whether having reference to leather or colour manufacture or dyeing—and agriculture. The textile industries, too, are catered for in a very complete manner. Facilities for research work also are provided in each of these departments. Similarly, the new calendar of the University of Sheffield gives full particulars of the faculty of applied science in the University. This department provides lecture and laboratory courses of instruction in the subjects of applied science required in the engineering, metallurgical, and mining industries, and awards degrees in engineering and metallurgy. It is a noteworthy sign of the times, also, that each university has a professor of education, and that modern attempts to place educational methods upon a scientific basis are receiving encouragement.

THE report of the principal of the Bradford Technical College for the session 1908–9 shows that the total number of students in attendance during the session was slightly greater than in 1907–8. In the day classes the total reached 221, fifty of these being apprentices. The total number of students in the evening classes was 887; 324 were concerned with the textile industries, 169 with chemistry and dyeing, and 394 with engineering. Of the 171 day students other than apprentices, it is satisfactory to find that more than a hundred had previously attended secondary schools. The standard of the entrance examination, which admits new students to the diploma courses, is being raised gradually, and should soon secure adequate

and suitable preliminary training for the students. Tenders for the extension of the college have been accepted by the City Council, and the building is now in course of erection. The scheme provides for an entirely new building for the department of textile industries, which is to be equipped with complete plants for the carding, combing, and weaving of textiles. There is also to be provided a small practical dyeing and finishing plant, capable of dealing with the material produced in the textile department. The committee has further decided to erect a power house equipped with various types of modern power-producing plant arranged for experimental use. These extensions constitute the most important developments of the institution within recent years, and, when completed, will place the college in the front rank as regards the facilities offered to students for experimental work in the textile and engineering industries.

## SOCIETIES AND ACADEMIES.

PARIS.

**Academy of Sciences,** October 4.—M. Bouchard in the chair.—A method permitting the measurement of the effective temperatures of the stars. First results: Charles **Nordmann.** A development of the photometric method described by the author in a previous paper. Values are given for fifteen stars, ranging from 2980° C. for the absolute effective temperature of ρ Perseus, 5990° C. for the sun, to >60,000 for λ Taurus. It is noted that the numbers found, with slight exceptions, are arranged in the order predicted by Sir Norman Lockyer from considerations based on the appearance of the *enhanced lines* of the spectrum.—The hypergeometric equation: Mme. V. **Myller-Lebedeff.**—The differential equations the general integral of which is uniform and admits mobile essential singularities: J. **Chazy.**—The measurement of high pressures deduced from the variations of resistance of conductors submitted to the pressures to be measured: A. **Lafay.** The change of resistance with pressure has been studied for platinum, mercury, and manganin. The first of these is not practicable for pressure measurements, since the temperature coefficient is more than 1900 times the pressure coefficient, and there are variations with different wires. Mercury gives more satisfactory results, but on account of its low temperature coefficient manganin is better.—The thermal properties of silver nitrate: M. **Guinchant.** Cryoscopic determinations with solutions of the nitrates of lithium, potassium, and thallium in fused silver nitrate gave cryoscopic constants agreeing closely with that deduced from the latent heat of fusion. Determinations were also made with lead nitrate, silver chloride, iodide, fluoride, iodate, and sulphate.—The examination of essence of turpentine: Paul **Nicolardot** and Louis **Clément.** Mixtures of pure essences with known quantities of resin oil, petrol, and white spirit were made, fractionally distilled both under ordinary and reduced pressure, and the physical properties of the fractions measured.—The decomposition of silver tetrachlorplatinate by water, and the preparation of fulminating platinum: Jules **Jacobsen.**—The magnetic disturbance and aurora borealis of September 25, 1909: Alfred **Angot.** This magnetic disturbance is the greatest that has been observed since the commencement of observations at the Parc-Saint-Maur Observatory in 1883.

NEW SOUTH WALES.

**Linnean Society,** August 25.—Mr. T. Steel, vice-president, in the chair.—Contribution to a knowledge of Australian Hirudinea, part iii.: E. J. **Goddard.** Three species are dealt with:—*Glossiphonia intermedia*, n.sp., from a creek near Fairfield; *G. heteroclita*, a European and North American form, now recorded as Australian also; and the common species, usually known as *Hirudo quinquestriata*, Schmarda, but which should bear the name *Limnobdella australis*, Bosisto, of which no adequate account had been published.—Australian fresh-water Polyzoa, part i.: E. J. **Goddard.** Six named species, representing six genera (including Alcyonella), and several unnamed forms, have been recorded from Australia and New Zealand, of which three species are endemic:—*Victorella pavida*, Sav. Kent; *Lophopus lendenfeldi*, Ridley; *Paludicella ehrenbergii*, van Beneden (New Zealand, *teste* Hamilton); *Plumatella Aplinii*, McGillivray; *P. princeps*, Kraepelin; P. sp., and Alcyonella sp. To these are now added *Fredericella australiensis*, n.sp., which grows luxuriously in the screening tank at Potts' Hill Reservoir, near Rookwood, and also in the 72-inch main from the end of the lower canal to Potts' Hill.—Mollusca from the Hope Islands, North Queensland: C. **Hedley.** In continuation of former investigations as to the coral-reef fauna of Queensland, the author organised another party to examine the reefs several degrees further north. The exact position selected was close to the scene of Captain Cook's misfortunes in the *Endeavour*. A week's work dredging and shore-collecting provided a series of about seven hundred molluscs. Of these, one hundred of the more interesting are discussed in the present communication, about half of which are introduced as new species. The novelties are distributed among the genera Chlamys, Cuna, Rochefortia, Sportella, Phacoides, Gafrarium, Chione, Tellina, Arcopagia, Semele, Theora, Liotia, Cyclostrema, Obtortio, Triphora, Cerithiopsis, Epitonium, Vermicularia, Odostomia, Turbonilla, Glyphostoma, Eulima, Marginella, Mangilia, Nassaria, and Retusa.

## DIARY OF SOCIETIES.

*FRIDAY*, OCTOBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

*WEDNESDAY*, OCTOBER 20.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Microscopical Structure of an Inoceramus Limestone in the Queensland Cretaceous Rocks: Frederick Chapman.

*FRIDAY*, OCTOBER 22.

PHYSICAL SOCIETY, at 5.—On Cadmium Amalgams and the Normal Weston Cell: F. E. Smith.—The Production of Helium from Uranium and Thorium: Frederick Soddy.—The Production of Radium from Uranium: Frederick Soddy.—Note on a Gravitational Problem: Dr. C. V. Burton.

## CONTENTS.