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ASEPTIC SURGERY.

The Collected Papers of Joseph, Baron Lister. Two vols. Vol. i., pp. xliv+429; vol. ii., pp. vii+589. (Oxford: Clarendon Press, 1909.) Price 2*l.* 2*s.* net.

ALTHOUGH the numerous papers collected in these two volumes were for the most part written thirty or forty years ago, their interest is in no way diminished to-day. Had the work of Lister failed to meet with due appreciation, his friends and pupils could have found no surer way of obtaining this than by the simple collection of his writings into these two volumes, and when one has said "this was his work," no further comment or eulogium is possible. In the records of most epoch-making discoveries one can read between the lines the character of the discoverer. At first sight it would seem as if the papers dealt with many and diverse subjects, but more careful study shows a remarkable unity, each one constituting a step towards the great work with which the name of Lister will always be associated.

With the exception of one or two isolated physiological papers, Lister's work was directed towards the elucidation of the meaning of the phenomena, which followed injuries to living organisms, commonly summed up under the term inflammation. Lister carried out a long series of experiments on the coagulation of blood, which must ever remain as a pattern of carefully planned and skilfully worked out investigation; and it was the relationship between inflammation and vascular thrombosis which determined the point from which he attacked this problem.

Lister's observations had for their object the study of blood coagulation in the vessels themselves, and he attempted to discover why blood which coagulated so readily when shed into a basin remained fluid in contact with living or surviving tissues. His experiments upon inflamed blood-vessels, conducted largely upon the web of a frog's foot, in spite of the large amount of work which has been done on this subject, require but little revision; his experiments on the pigmentary corpuscles in the frog form one of the most brilliant demonstrations of the effect of injury on the tissue cells as distinguished from changes in the blood-vessels.

Naturally, however, the greatest interest of Lister's work centres around the papers on the use of antiseptics. Surgery was not merely revolutionised—a new science was born.. His article on "A New Method of Treating Compound Fracture, Abscess, &c., with Observations on the Conditions of Suppuration," gave the result of two years' experience in the new methods. This paper was published in 1867, and reading it to-day it is difficult to conceive why theories so ably argued and so conclusively proved failed to obtain immediate acceptance; but for many years Lister shared the common fate of reformers, and had to cope with misunderstanding and misrepresentation. It is appalling to think that in the great war of 1870 and 1871 no real attempt was made to use the methods which Lister had employed for four years. The opposition, however, to Lister's methods was not unique, for in the article on anæsthetics in these volumes, written in 1861, seventeen years after the discovery of ether, Lister remarks

"that such being the great benefits conferred by this agent it is melancholy to reflect that in many parts of Europe and even of the United Kingdom it is either withheld altogether or given so scantily as to be nearly useless."

The "sepsis" which Lister was attacking was not the sepsis which is known to-day, but actual putrefaction of the discharges from wounds, to which were attributed the septicæmia, pyæmia, and hospital gangrene which were so prevalent before the antiseptic era. It is hard to-day to think of being familiar with

"the faint sickly smell commonly perceptible in surgical wards under ordinary treatment, and still more with the stench which prevails at the time of the daily dressing";

but at that time it was a matter of common experience. The value of the antiseptic method could not have been more severely tested than in the original men's accident ward in Glasgow Infirmary, in which it was first put in practice. Separated from this ward by a passage 12 feet wide was another similar ward, in which the death-rate from pyæmia and hospital gangrene was so high that it attracted the attention of the authorities even at this time. An excavation was made, and it was found that on a level with the floors of these two wards, with only the basement area, 4 feet wide, intervening, was the uppermost tier of a vast number of coffins, placed there during the cholera epidemic of 1849. In addition to this, one end of the surgical hospital abutted on the cathedral burial yard, in which the revolting practice of pit burial was carried out; that is to say, bodies of paupers enclosed in rough coffins were placed in large pits, which were loosely covered up with boards, and only filled in with earth when the pit was full. In such circumstances as these, Lister was able to state, at the British Medical Association meeting in Dublin, that for the nine months in which the antiseptic system had been in proper working order not a single case of pyæmia, erysipelas, or hospital gangrene had occurred in his ward, although these diseases were exceptionally rife in the other wards of the hospital.

In the first attempts at antiseptic surgery, German creosote, a crude form of carbolic acid, was introduced into the wound on a strip of lint, which was in some cases left in position; some fresh antiseptic was mixed with the blood exuding from the wound so as to form a crust, the carbolic acid in which was then prevented from evaporating by a piece of block tin; this was removed once or twice a day, and fresh carbolic acid painted on the crust to supply the place of that which had evaporated. Crude and irritating as this method was, its results were an enormous improvement on any that had been previously obtained. Of the first eleven cases of compound fracture and

dislocation treated in this way only one died, although at this time recoveries were extremely rare, and the accident was regarded as one of the most dangerous known to surgeons.

Carbolic acid was first brought to Lister's notice by reading accounts of its deodorising action upon the sewage of Carlisle, and it is interesting to note that this, the first substance used by Lister in his antiseptic method, still retains its pre-eminence as an all-round antiseptic.

These first methods were only a beginning, and throughout the whole course of his active life Lister busied himself in perfecting his method, striving to find means whereby asepsis could be secured with a minimum irritation of tissues, without deviating in the slightest degree from those scientific principles which had guided him at the outset of his work.

The conquest of suppuration not only perfected older operations, but opened the way for new ones, and Lister himself introduced a large number of these. Joints, interference with which had been looked upon as utterly unjustifiable, were opened with impunity, fractures with vicious union were exposed and rectified, new principles in amputation introduced, and the use of the aseptic ligature, by obviating the risks of hæmorrhage, removed one of the greatest dangers of surgery.

Not the least interesting of the papers collected in these volumes is that on anæsthetics, a subject to which Lister devoted a considerable amount of attention, and in view of the recently proposed legislation it is interesting to note that Lister strongly disapproved of specialists in this branch of practice, holding that the administration of an anæsthetic called for care rather than for special skill and experience.

Lister in all his writings frankly and gratefully acknowledged and appreciated the work of others, especially Pasteur, and that "hard-worked general practitioner," Koch. His work is its own monument; it has given modern surgery to mankind, and so simplified its performance that operations can be performed without any particular comment which fifty years ago would have left the whole world aghast at their daring.

A NATURALIST IN ECUADOR.

Nel Darien e nell' Ecuador. Diario di viaggio di un Naturalista. By Dr. E. Festa. Pp. xvi+397. (Torino: Unione Tip.-Editrice Torinese, 1909.) Price 10 lire.

DR. E. FESTA'S main object was the zoological exploration of Ecuador. However, as the isthmus of Darien or Panama lies on the way to Ecuador, and since this interesting country happened to pass through one of its revolutions, he spent the time from the months of May to September, 1895, on the isthmus, chiefly among the intricate inlets of the Gulf of San Miguel, on the Pacific side, extending thereby his collecting over every class of the animal kingdom, from sponges to mammals.

After the political conditions had become a little more settled, he went to Ecuador in September, 1895, and stayed there to April, 1898. Entering the country by Guayaquil, he travelled east to Cuenca and beyond, to the headwaters of the Rio Santiago of the Marañon system, and northwards by Quito to Julian, near the frontier of Colombia. His travels, extending, roughly speaking, from 4° latitude south to 1° north, and between 80° to 78° longitude west, cover only a small part of the vast country of Ecuador, but he explored it thoroughly.

He was much indebted to the President of the Republic; for instance, on the strength of his official credentials the local authorities occasionally commandeered porters and mules. Above all, he was helped by the missions of the Società Salesiana de Torino, and he had the inestimable advantage of being accompanied on his perilous excursions through the forests of the Santiago district by a former compatriot, Sr. G. Pancheri. An agreeable feature was the hospitality offered by many Ecuadorean owners of haziendas. About 500 specimens of mammals, more than 3000 birds, 150 different kinds of reptiles and amphibians, as many kinds of fishes, and ever so many invertebrates, were brought together and given to the Royal Museum at Turin. They testify to the richness of the fauna, and last, not least, to the enormous labours of Dr. Festa and the Italian collector whom he was able to take with him. However, they took whatever kind they could, and of every kind as many specimens as possible. For instance, no fewer than nine condors were shot at one spot, and in typically national style the travellers spread nets in forest and garden, and gloated over the numbers of little beauties ensnared. The step thence to that pest, the plume-hunter, seems but small; at least, it is a bad example to the natives.

Naturally our author experienced many ups and downs, but he had no hairbreadth escapes, as such are now of rare occurrence to veracious travellers. Already in the mangrove swamps of Darien he suffered much from fever and severe gastric troubles, and camp life was often utterly spoiled by the pests of insects. It was not only the stinging, poisonous kinds, but a great aggravation were the stingless bees, Melipone, big and small, which in their numbers insinuated themselves into the hair, mouth, nose, and ears. To make work possible, the traveller had to put smouldering branches upon the table. Some kind of Oestrus stung Dr. Festa in the abdomen, causing several months of torment, and after opening the swelling he extracted a fat maggot, four centimetres in length. The horses suffered indirectly from the bites of the blood-sucking bats, Desmodus, because flies deposited their eggs in the little wounds, and the maggots caused enormous ulcers. Sand-fleas, *Sarcopsylla penetrans*, were a plague in many places, and every specimen of digging rodents had its feet infested with them.

Several specimens of the Andine bear, *Tremarctos ornatus*, were procured. This creature, preferring to travel in comfort, prepares its bed on the ground, by covering a space about a yard in diameter with branches and twigs to lie upon during the night.

After having found such "beds," the travellers came across a family of bears, which had their lair at the foot of a tree, hidden by dense foliage. When dislodged, some of them climbed about rapidly.

The beautiful Morpho butterflies were abundant at places, and not at all shy. On the contrary, they alighted upon the table and sucked from the dishes during breakfast. At Cuenca Dr. Festa was treated to the spectacle of a fierce battle, which lasted all day long, and on the following day the victor entered the town after a loss of 900 dead. A rather full and interesting account is given of the Iivaros tribe of Indians, who, not yet appreciating the value of money, required knives, guns, needle and thread, &c., for barter. The wilder they were, the better they were as collectors. Their special weapon is the blow-pipe. A favourite ornament of both sexes, besides painting themselves, is a wooden lip-plug, one inch long and half an inch thick, with pendants of needles, the brightly-coloured wings of beetles, &c. The house is large, of the type of the communal house, the sexes occupying different quarters of the same large room, and to each woman's bed are tied several fierce watch-dogs.

In the mountains of the province of Carchi were procured a considerable number of antique specimens of pottery and some crania.

Unfortunately, this book is written mostly in the style of a diary, which does not well lend itself to generalisations, but rather to matter-of-fact records of animals and plants observed. It would have been interesting to read how the Ecuadorean civilisation appeared to an Italian, a cultured representative of another Latin race. The English-speaking civilisation is too divergent from the Latin-American in almost every walk of life really to understand it and to appreciate its many good points. However, the author is modest, and enlivens his account of the many things he has done and seen with but little humour.

The book, printed in excellent type and on very good paper, and adorned with some seventy or eighty, mostly full-paged, beautifully reproduced photographs, seems wonderfully cheap for the price of 8*s*.

AUSTRALIAN ANIMALS.

The Animals of Australia. Mammals, Reptiles, and Amphibians. By A. H. S. Lucas and W. H. Dudley le Souëf. Pp. xi+327. (Melbourne: Whitcombe and Tombs, Ltd., 1909.) Price 15*s*. net.

MESSRS. LUCAS AND LE SOUËF have given us a book which ought to find a very hearty welcome, especially amongst Australian naturalists. Whilst intended primarily for the general reader, the arrangement and treatment are throughout thoroughly scientific, and the illustrations, many of which are from original photographs, are, on the whole, very good. The full-page photograph of a wheelbarrow on p. 179 is perhaps a little superfluous, however. It is true that the wheelbarrow contains a snake, but it is a very small one, and a much better photograph of the same snake is given on another page.

The information that the number of Australian species of Eutheria is the same as that of the marsupials (106) comes rather as a surprise, even if, as we suppose, it includes introduced species.

The authors have a melancholy tale to tell of the rate at which the marsupials are being exterminated for the sake of their skins. It appears that no fewer than 873,837 "opossum" skins were offered for sale in the Sydney market alone during the year 1908, and other species in hardly less alarming numbers.

The section dealing with the snakes is one of the most interesting. Death from snake-bite appears to be rare in Australia, although many of the species are poisonous, and some of them deadly. In case of snake-bite, however, most people prefer to err on the safe side, though there are probably not many who have so much to show for their mistake as the man who exhibits to his friends a bottle containing one of his own fingers and a perfectly harmless snake by which it had been bitten! Snake-stories form an important part of the literature of the Australian bush, but we do not recollect having heard before about the tiger-snake which was found enjoying a sun-bath balanced on the topmost wire of a fence, with the folds of the body nicely adjusted on each side to maintain the balance. We are told that the Australian snakes do not charm or fascinate their prey in any way (p. 156). If this is so, we are at a loss to understand the photograph on p. 181, which, at first sight, at any rate, looks like a snake fascinating a hen; perhaps, however, the hen is refusing to be fascinated.

One difficulty which has to be overcome by the writer of a popular book on natural history in a "new" country is the absence of a popular terminology. To some extent Messrs. Lucas and le Souëf have endeavoured to supply this deficiency; notably in the case of the Agamid lizards, for which they suggest the name "Dragons." Thus *Amphibolurus maculatus* is to be known as the "Military Dragon," presumably on account of its brilliant colours; but we should hardly have thought that "Queen Adelaide's Dragon" was an appropriate rendering of *Amphibolurus adelaidensis*, the termination of the specific name suggesting a geographical rather than a personal reference. In a few cases the Australian public has already taken the matter of nomenclature into its own hands, as in the well-known case of "Goana," which is, of course, a corruption of "Iguana," a name popularly but erroneously applied to the "lace monitor" (*Varanus varius*).

Although the book does not profess to deal with the fishes, the authors have not been able to resist the temptation to include an account of Ceratodus, evidently on the ground that it is "part fish, part amphibian." The amphibian part seems hardly sufficient to justify its inclusion, but we must admit that the temptation was very strong.

The book is well got up, though the paper is unpleasantly glossy. We can strongly recommend it to all who are interested in Australian natural history.

MACHINE DESIGN.

Elements of Machine Design. By Dr. S. Kimball and J. H. Barr. Pp. viii+446. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s.* 6*d.* net.

THIS is an important work on a subject which it is difficult to treat in systematic manner on account of the great complexity of the conditions involved. The variety of machines now made is almost overwhelming, and is continually increasing, while for the successful and intelligent design of machines of any one class the engineer must possess a faculty of invention, a sound judgment, some acquaintance with commercial conditions, familiarity with workshop processes, a knowledge of the many branches of applied mechanics and of physics, all the result of long study and practical experience. The treatment of so extensive a subject must of necessity be only partial, and the primary appeal of this book is to students of technical colleges. At the same time, the expert draughtsman will find much of interest and profit. The drawings are subordinate, and are introduced mainly to illustrate principles. The treatment is logical yet practical, very suggestive and germane to the subject, and the style is attractive and interesting. The writers can speak with authority, each having had experience as a professor of Sibley College, Cornell University, and also as a manager of an engineering works.

The authors begin with some examples illustrating the energy changes which take place in a machine during a cycle of operations, the object of the investigation being to determine the maximum value and range of the force actions which occur. Then follows an explanation of how the parts are to be designed so as to withstand successfully these straining actions, and a very complete and well-arranged collection of formulæ for the strength and stiffness of beams, shafts, struts, &c., is given. The discussion of the considerations which affect the choice of a suitable factor of safety will here be found very helpful.

The chapter on friction, lubrication, and efficiency is extremely interesting and suggestive. The investigations on lubrication by Beauchamp Tower and later experimentalists are quoted and analysed, and their significance explained. Subsequent chapters are devoted to machine details, comprising springs, riveted joints, screws and bolts, keys and cotters, tubes and pipes, constraining surfaces for sliding and turning motions, shafting and couplings, belt, rope, and chain transmission, friction wheels and brakes, spur, bevel and screw gears, flywheels, pulleys and rotating discs, and, lastly, machine frames.

The chapter on constraining surfaces is one of the best in the book. Some of its drawings exhibit modern types of cylindrical and thrust bearings, and ball and roller bearings. In the general discussion the authors enter fully into the permissible bearing pressures, the details for securing efficient lubrication, the dissipation of heat from the bearing, and all the conditions for successful design. Indeed, every chapter is suggestive and interesting, but enough has been said to indicate the general character and scope of the work. We must, however, not overlook the numerical examples which are introduced at intervals, and used to illustrate and suggest the proper treatment of problems in design. Mention should also be made of the many references to publications, to assist readers who desire further information.

Altogether, the authors are to be congratulated on the production of a very instructive, well-arranged, and well-written treatise on the elements and principles of machine design. The book should be in the library of every engineering school and college.

THE ATRIUM OF SOUTH AFRICA.

An Introduction to the Geology of Cape Colony. By Dr. A. W. Rogers and A. L. Du Toit. Second Edition. Pp. xiv+492. (London: Longmans, Green and Co., 1909.) Price 9*s.* net.

THIS handbook is the second edition of that reviewed in 1905, and the progress made since then in South African geology renders its appearance all the more welcome. Dr. Rogers has associated his colleague, Mr. Du Toit, in the authorship, and the preparation of the new material has no doubt raised pleasant memories of many a long campaign, in lands where the horizon always seems to call one further, until the rim of the world sweeps up against the sunset, and another night is spent beneath the stars.

The complete revision of the work makes it virtually a new one for purposes of reference; and the coloured map is now on a larger scale, and covers additional ground, notably in Griqualand West. Two sections illustrate the folded margins of the colony, and the broad synclinal of the Karroo system, which in places measures 450 miles from side to side. The correlation of the pre-Devonian rocks (p. 5) is considered in some detail, and reasons are given (p. 110) for the retention in this group of the "continental" Matsap system on the fringe of the Kalahari. The Karroo system, from the Lower Dwyka beds to the volcanic capping of the Drakensbergen, is compared (p. 233) with South American and European strata, on the basis of recent literature. The glacial Dwyka beds, composed of the so-called "tillite," may be Upper Carboniferous or Lower Permian; but the reptilian fauna places the Upper Dwyka series in the Permian. The Beaufort beds, with Pareiasaurus, Oudenodon, and the freshwater molluscs Palæomutela and Palæanodonta, are paralleled by the Russian Permian. The Upper Beaufort or Burghersdorp series is, however, probably Triassic; so also are the succeeding Molteno beds, regarded as equivalents of the Rhætic. The Stormberg series, if we except the Molteno beds, is held to be Jurassic. Dr. Broom has entirely re-written his chapter on the Karroo reptiles, and points out that Tritylodon, which he has elsewhere shown to be most probably a Jurassic form, may be retained among the mammals.

The chapter on the volcanic pipes younger than the volcanic Stormberg series has been expanded, but no longer contains the sections of the rock-shafts at Kimberley. The relationship of their igneous infilling, known as kimberlite, to melilite-basalt (p. 364)

is emphasised by new evidence from North America, in addition to that known from Cape Colony. A brilliant suggestion of Carvill Lewis becomes thus fully justified.

In the fine chapter on the geological history of the colony, the influence of Prof. W. M. Davis (p. 451) now becomes justly manifest. There was little to modify, however, in Dr. Rogers's original review of the great processes that have made South Africa. His suggestion that the S-bends of the rocky gorges in the south are the descendants of meanders formed when the rivers ran over a great plain remains happily unaltered. If South African geologists have learnt willingly from friends whom they invited in 1905 to the coast-ranges and the veld, it will be long before those friends can repay what they themselves received. The guidance then given by Dr. Rogers is renewed and extended in the present admirable volume.

G. A. J. C.

OUR BOOK SHELF.

The Romance of Modern Chemistry. By Dr. J. C. Philip. Pp. 348. (London: Seeley and Co., Ltd., 1910.) Price 5*s*.

ACCORDING to its subtitle, this book is "a description in non-technical language of the diverse and wonderful ways in which chemical forces are at work, and of their manifold application in modern life." After some prefatory historical and theoretical matter, the reader is provided with a wealth of brightly-written and interesting information about fuel and its uses, explosives, low-temperature and high-temperature appliances, and spectroscopy. Modern phases of agricultural chemistry and of industries relating to sugar, starch, fats, and oils are discussed, and the concluding chapters give well-chosen illustrations of applied chemical science in relation to the adulteration of food, the utilisation of by-products, coal-tar products, large-scale electrolysis, solutions, crystals, and industrial catalysis. The last chapter illustrates vividly the part that "accident" has played in chemical discovery.

The most formidable difficulty in writing a book of this kind is to get the reader sufficiently acquainted with the elements of chemical fact and reasoning to enable him to understand the applications. Dr. Philip has adopted a light treatment and allowed himself a free use of imagery of an anthropomorphic kind, which will probably make an impression. To a reader who knows just a little chemistry the interest from the beginning of chapter vi. to the end of the book (chapter xxx.) will be kept fully alive, and as the body of information contained in these chapters is just that which is apt to be omitted from school or evening-class courses of formal chemistry, the book has a very distinct place of usefulness. It is written with an unimpeachable knowledge of scientific chemistry, a very unacademic appreciation and knowledge of practical problems, and a certain amount of human nature, which make the best possible equipment for the author of a book intended to popularise science. The chapter on solutions is particularly worthy of mention as an example of admirable exposition. There are twenty-nine excellent illustrations, which have been selected with care and at considerable trouble, but a long accumulating detestation of the very names stalactite and stalagmite would have reconciled the present writer to a suppression of the three plates dealing with these bedridden natural and etymological phenomena.

A. S.

Hayward's Botanist's Pocket-book. 13th edition. revised and enlarged. By G. C. Druce. Pp. xliv+280. (London: George Bell and Sons, 1909.) Price 4*s*. 6*d*. net.

THE "Botanist's Pocket-book" is well known as a handy companion of a convenient size for the pocket, and containing sufficient data to determine ordinary plants in the field. The original work, published in 1872, was enlarged in 1886 by the addition of an appendix, but, as many changes have recently been rendered necessary, the publishers have wisely authorised Mr. G. C. Druce to make a thorough revision. The general plan remains the same, but there is evidence of Mr. Druce's emendations from the first page to the last. Notably, the synopsis of the natural orders has been corrected, the arrangement of the genera has been altered, and both genera and species have been carefully revised to incorporate the conclusions of present-day authorities and present the nomenclature in accordance with the recommendations of the Vienna Congress.

The revision gives all species and varieties, even certain hybrids, except for the genera Hieracium, Euphrasia, and Rubus. Although the identification of many critical species and varieties will not be decided in the field or even on the scanty data supplied, botanists will not cavil at the decision to include them, especially as it has not necessitated an increase in the size of the volume. It is not apparent why the family names Lamiaceæ and Graminaceæ have been coined, while the substitution of Pinaceæ for Coniferæ to include Taxus cannot be accepted; further, it would have been less perplexing to many botanists to find the nomenclature if not the sequence of the last edition of Babington's "Manual." Doubtless the last point has received the consideration of the reviser, who has rendered another service to botany by placing on record his conceptions based on many years' constant study of British plants.

Yorkshire Type Ammonites. Edited by Mr. S. S. Buckman. Part I. Pp. i–xii, *i–ii*, plates 12, and descriptions Nos. 1–8. (London: W. Wesley and Son, 1909.) Price 3*s*. 3*d*. net.

IT is intended that this work shall appear in about sixteen parts. The object of the publication is to give an adequate pictorial and critical revision of the type-specimens of Jurassic ammonites from Yorkshire which were unsatisfactorily described or figured by the early authorities Young and Bird, John Phillips and Martin Simpson. The treatment is similar to that in the well-known "Palæontologia Universalis," and the excellent illustrations in collotype process are from photographs of the actual specimens, mainly by Mr. J. W. Tutcher. In addition to a reprint of the original diagnoses, supplemented by useful critical remarks, the editor has supplied a clearly arranged and concise account of the comprehensive system of terminology which has been adopted by those who have made the most advanced studies of ammonite-development. He has also added some original and suggestive remarks on the cyclical development of the shell-form. In another section of the work there are useful notes on generic names. Twelve plates are issued in the present part, with text relating to eight species, and the introductory matter is uncompleted. This work will prove indispensable, not only to those who take a serious interest in Yorkshire geology, but to all students of Jurassic ammonites.

Klimatographie von Österreich. Part IV. *Tirol und Vorarlberg.* By Dr. H. v. Ficker. Pp. vi+162. (Vienna: Gerold und Komp, 1909.)

THIS volume forms part iv. of the valuable handbook on the climatology of Austria which is being issued by

the Zentralanstalt für Meteorologie und Geodynamik of Vienna. It deals with the Tyrol and Vorarlberg, and has been prepared by Dr. H. v. Ficker with the cooperation, in the botanical and zoological part, of Prof. von Dalla Torre. The region under discussion is one of special interest by reason of the great contrasts which it presents. The North Tyrol is formed by the valley of the Inn and its tributaries. Here we have a long valley running east and west, and protected both to north and to south by high mountains. Föhn winds are frequent, and have a decided effect in raising the mean temperature. As a result many flora and fauna which are characteristic of more southern latitudes manage to persist. In the South Tyrol the main valleys, Etsch and Eisach, run from north to south. To the north they are protected by the central Alpine range, but to the south they are freely open to the plain of the Po. The Pustertal, running west to east, forms a region by itself. It is freely exposed to winds from the east, which have a decided influence in lowering the winter temperature. Finally, in Vorarlberg we have again a different arrangement. The valleys slope down to the north-west towards Lake Constance. This fact has an important influence on the climate, as the prevailing wind over this part of Europe is from north-west. The climatological data are discussed on the lines suggested by Hann in his "Lehrbuch der Klimatologie," which have been followed also in the previous volumes of the series. The peculiarities of each region are clearly set out and contrasted with one another.

The Scholar's Book of Travel. Part i., The British Isles and Readings in Physical Geography. Pp. viii+197. Part ii., Europe. Pp. viii+198. Part iii., Other Lands. Pp. viii+200. Part iv., The British Empire. Pp. viii+200. (London: George Philip and Son, Ltd., n.d.) Price 1*s.* 3*d.* each.

Cambridge County Geographies. Cambridgeshire. By Prof. T. McKenny Hughes, F.R.S., and Mary C. Hughes. Pp. xiii+271. (Cambridge: The University Press, 1909.) Price 1*s.* 6*d.*

THE teaching of geography in this country is undergoing a complete change. Efforts are being made in every direction to create interest in the human aspects of geography and also to render the study of the subject a training in the methods of science. The pupil is no longer merely set to learn by heart lists of geographical data, but he is encouraged by the study of maps, by simple experiments, and by reference to original sources, to discover and to arrange facts for himself, and by his own efforts to arrive at simple, broad geographical principles.

"The Scholar's Book of Travel" is designed to provide the young pupil with literary extracts from books of travel, and to give him the opportunity of learning from first hand accounts about this and other countries. The four little volumes should serve a distinctly useful purpose, especially as they will probably send the learner to the excellent books from which the extracts are taken. The majority of the excerpts are from the older writers—Livingstone, Speke, Mungo Park, Defoe, Kingsley, Darwin, to name a few—but the beauty and interest of the passages will doubtless make the reader desire to read the works of modern travellers.

The volume dealing with Cambridgeshire follows the general lines of the series to which it belongs, and these have been described on previous occasions. The authors provide an excellent account of an interesting county, and readers will find that though called geography the book gives particulars of the geology, history, antiquities, architecture, and the roll of honour of the district.

LETTERS TO THE EDITOR.

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

The Fertilising Influence of Sunlight.

THE past history of agricultural science furnishes several examples of belated explanations of the utility of practices the value of which has long become a tradition among practical men. The explanation of the value of leguminous crops in agriculture is a good example. While the recognition of the *rôle* of these crops in increasing the nitrogen supply in the soil has done much to improve agriculture in new countries, it has only served to provide a scientific approval of the cultural practices of ancient civilisations, such as that of India, where from time immemorial it has been the custom to grow leguminous crops in the rotation and also as one of the constituents of the mixed crops cultivated in many parts of the country.

Agricultural science has recently provided another explanation of an ancient Indian practice. In the *Journal of Agricultural Science* of October last, Drs. Russell and Hutchinson have found that partial sterilisation of the soil by heating or by poisons leads to an increase in the supply of nitrogenous compounds and to increased fertility. These investigators state that partial sterilisation of the soil kills off the phagocytes which live on bacteria, and also large organisms inimical in other ways to bacteria. At the same time the soil bacteria are killed off, but the spores remain which germinate and rapidly multiply when the soil is moistened. The new bacterial cultures increase at an enormous rate, and the resulting nitrogenous plant food becomes so great that plant growth is greatly stimulated. The authors then go on to state (p. 120):—"There is reason to suppose therefore that the large destructive and competing organisms will be found of common occurrence in ordinary soils, checking the beneficial bacteria and limiting fertility. An important practical problem arises: is it possible to suppress them in ordinary field soils by any economical and practical process?"

The practice among many of the best cultivators in the Indo-Gangetic plain furnishes a most emphatic affirmative to the above question. It has been the practice of the ryots for centuries past to expose the alluvial soils of the plains of India to the intense heat and light of the Indian hot weather in April and May. The beneficial result on the succeeding crop is extraordinary, and has all the effect of a nitrogenous manuring. It is much more than probable that the result of this weathering is a partial sterilisation of the soil, and that Russell and Hutchinson's explanation is the correct one. Except in market-garden crops near the cities and in crops like sugar-cane and tobacco, manures are but little used in India. The growth of leguminous crops and the weathering of the soil during the hot season appear to be sufficient to keep up the fertility. More nitrogenous manure would no doubt be an advantage, but a great deal could be done by the cultivators themselves in weathering the soil during the hot weather in a more efficient manner than at present.

The extended use of cheap light iron soil-inverting ploughs during the hot, dry weather after the *rabi* harvest would do much to bring about a better exposure of the soil to the sun, and a more complete sterilisation. The wooden ploughs now in use are not adapted to open up the heavier lands unless they are moistened by rain, and in consequence a large area of the arable land is not ploughed at all until the monsoon. We consider one of the greatest improvements possible in Indian agriculture would be to impress on the ryot the value of weathering all arable lands in April and May to a much greater extent than is done at present. When iron has taken the place of wood in the ploughs of the Indo-Gangetic plain, it will be possible for the cultivator to take the fullest advantage of, and greatly extend, their present most admirable practice. In collaboration with Mr. H. M. Leake, economic botanist to the Government of the United Provinces, we have in progress a series of experiments in which the practical

effect of weathering during the hot months on both the yield and quality of wheat is being ascertained.

A. HOWARD.
G. L. C. HOWARD.

Pusa, November 18, 1909.

A Note on the Gilded Metal-work of Chiriqui, Central America.

AMONG the minor ethnological problems which America offers in such variety, not the least interesting is that of the origin, significance, and method of production of the specimens of gold-work found so abundantly in certain parts of Central America and in the north-western regions of the southern continent.

The earliest European voyagers who reached the shores of the New World directed attention in their narratives to the gold ornaments and little images of "frogs, birds and men" found in the hands of the natives, and, as Humboldt urged long ago, arguing erroneously from the accumulated riches of generations of savages, they attributed great mineral wealth to the newly discovered lands, giving them such sounding names as Costa Rica and Castillo del Oro.

Articles of gold alloy are widely distributed throughout South America, and vary as greatly in artistic and technical execution as in the purity or baseness of the metal from which they have been fashioned. This metal-work has long been known to students, as well as to treasure-hunters, and is of so extraordinary a character that it at once attracts attention. Running riot, heedless of the proprieties, its motives include every variety of zoomorphic design—human, bestial, bird, fish, or reptile; all types of life are represented, together with monstrosities and ambiguous shapes bordering frankly on the diabolical.

A certain amount of South American metal-work finds its way every year to England through dealers who purchase it from natives and speculators who make it their business to explore the ancient burial places. Practically the whole of this is melted down on account of its intrinsic value, but it is comparatively seldom that objects of artistic or archæological interest are lost to science in this manner, by far the greater portion of the work being of the crudest description.

The present letter deals more particularly with the gilded metal-work of Chiriqui, on the southern boundary of Costa Rica, which presents features of peculiar interest. It has been studied carefully by Holmes, whose work on the subject, embodying references to the earlier literature dealing with it, is to be found in the report of the Bureau of Ethnology for the years 1884–5.

The immediate interest of the subject turns upon the occurrence of objects fashioned from copper-gold alloys of very variable composition, the latter metal being present in some instances in a proportion insufficient sensibly to alter the colour of the copper, whilst, nevertheless, the surface of the objects presents a burnished coating of fine and splendent gold. In many examples the film of precious metal is so slight that it has all the appearance of electro-plated work, and many conjectures have been hazarded to explain the method by means of which the native artist produced the effect.

Holmes, in the treatise already cited, quotes, on the authority of Bollaert, a reference to the works of Acosta to the effect that the Indians of New Grenada gilded copper by rubbing it with the juices of certain herbs and afterwards subjected it to the action of fire, when it took the gold colour, but states that he had not been able to find the passage in question. The present writer has also searched the pages of Acosta in vain, but it is probable that Bollaert quoted from memory the following passage in the "History of the Indies" of Gonzalo Fernandez de Oviedo (Edit. Amador de los Rios, vol. iv., p. 189), where that writer says, freely to translate the paragraph:—"I would wish to say how the Indians [of the Antilles, and especially those of Hayti] know well how to gild the little things they make of copper, very yellow like gold. They have in this such skill and excellency, and give such a deep lustre to that which they gild that it seems to be good gold of 23 carats or more by its colour when it leaves their hands. This they do with certain herbs, and is such a great secret that whoever of the goldsmiths of Europe or of any other part shall find it out, he will be a very rich man, and that in a very short time if he uses this manner of gilding." The old historian of the Indies made efforts to learn from the Indians this secret process, but they excused themselves on the plea that the herbs made use of were unknown to them, and that the small quantity they possessed of them came from very distant countries.

"It is not impossible," says Holmes, "that an acid may have been applied which tended to destroy the copper of the alloy, leaving a deposit of gold upon the surface, which could afterwards be burnished down. . . . It is possible that the film of gold may in some cases be the result of simple decay on the part of the copper in the alloy . . . but the surface in such a case would not be burnished, whereas the surfaces of the specimens are all neatly polished."

The operation above mentioned, whereby the apparent quality of articles of gold alloy is improved by the artificial enrichment of the superficial layer, is one frequently practised among goldsmiths, who term it "colouring." A hot process, involving the use of fused salts, is generally made use of (*vide* T. K. Rose, "Metallurgy of Gold," edit. 1906, p. 19; W. T. Brantt, "Metallic Alloys," London, 1896; and Gee, "Goldsmith's Handbook," 1881).

Considering it probable that a germ of truth lay in the information given by the Indians to Oviedo, the writer made several experiments of a simple character to endeavour to clear up this point. It was found that by acting upon a base alloy with dilute nitric acid, a black lustrous film of gold could be readily obtained by removing in solution a portion of the copper. By heating the object thus treated out of contact with air, the black film of gold is annealed, changing to the yellow modification, and is left in a condition to be readily burnished with any suitable implement, for example, a water-worn pebble of quartz.

The mineral acids being, presumably, unknown to the craftsmen of pre-Colombian America, advantage was taken of the solubility of copper in organic acids in the presence of air, and after a few successful preliminary experiments with the pure chemical products, various acid plant juices, the "herbs" of Oviedo's Indians, were tried, and fully answered expectation. There can be little doubt that the Indians had no need to ransack "distant countries" for the wherewithal to gild their ornaments; but every craft has its mysteries.

It was found that among the various organic substances tried in the course of the experiments few effected the required reaction so readily as urine, which, with free access of air, rapidly covers the surface of the alloy with a coating of hydrated copper salt readily soluble in acid plant juice. When performed with the aid of these natural reagents, the operation is a very tedious one, the gold film, in the case of base alloys, taking months to acquire sufficient substance to admit of being burnished; but time signifies little to the savage.

In conclusion, although not desirous of affirming that the procedure described was that invariably followed by the Indians in the production of gilded work, the writer is decidedly of the opinion that their operations broadly followed the lines indicated in the present letter.

OSWALD H. EVANS.

"Arauco," South Harrow, February 1.

Suggested Common Day of Meeting for London Societies.

WILL you permit me to make a suggestion regarding the days of meeting of learned societies in London? At present these days seem to be selected in a very arbitrary manner, with the result that the provincial members of the societies are often called to London on several days during the same week. For instance, last autumn I ought to have attended no fewer than four such meetings during the same week, namely, on Monday, Tuesday, Thursday, and Friday. It is, of course, impossible for the majority of provincial members of London societies to give up so many days—we are generally compelled in such circumstances to abandon all the meetings. By some curious law

of chance, moreover, it generally happens that two meetings occur with just an interval of one day between them, which makes it still more difficult to attend either.

Would it not be possible to fix one day, namely, Friday afternoon and evening, as a general day of meeting for the societies? This would, I feel sure, allow many provincial members to come down to London for the occasion, partly because they could merge the Friday with their "week-end," and partly because they might have the chance of attending several meetings the same afternoon and evening. I doubt whether such an arrangement would inconvenience many of the London members; but, even if it does, the London members might perhaps be willing to give way, because to them, in any case, attendance is much more easy than it is to men who live perhaps hundreds of miles away. I have discussed the matter with several friends in Liverpool, all of whom seem to be favourably impressed with the idea. RONALD ROSS.

Johnston Tropical Laboratory, University of Liverpool, February 5.

The Meaning of "Ionisation."

IN his interesting notice concerning the work of Arrhenius, published in NATURE of February 3, Prof. Walker, in a somewhat ambiguous manner, refers to "the notion and practical definition of degree of ionisation" as the great positive contribution of the distinguished physicist. "Whatever be our views of the origin and nature of ions, we must" . . . —he says—"have recourse to the notion of degree of ionisation." It is a little difficult to see how we are to have recourse to a notion if we are not clear what view that notion is based upon and includes. To appreciate Prof. Walker's position, it is essential that we should know precisely what meaning he attaches to the words I have quoted—what conception underlies them. I would beg Prof. Walker to tell us, in clear, unmistakable terms, what exactly he would have us understand by the word *ionisation*.

When the Royal Society has completed its Catalogue of Scientific Papers of the last century, it will doubtless be compelled to prepare a dictionary in explanation of the terminological inexactitudes to be found in its Proceedings and other journals; of these, *ionisation* will be one of the most difficult to interpret. Prof. Walker will render real service if he will tell us in what sense or senses he uses the word throughout his notice; does he or does he not use it as connoting explicitly the separation of a substance in solution into several portions, each capable of acting as a distinct kinetic unit? This, I believe, was the doctrine enunciated by Arrhenius in 1887, and which, if I mistake not, he still professes. Does Prof. Walker advocate such doctrine?

HENRY E. ARMSTRONG.

PROF. ARMSTRONG and I look at *ionisation* from different points of view. He is chiefly interested in an interpretation of the process and phenomena of ionisation in terms of the kinetic molecular theory. I am chiefly concerned to have a theory, whatever be its exact mechanical interpretation, which is capable of being mathematically formulated and of acting as a guide in quantitative investigation. My position, in short, is that of the astronomer who is content to have Newton's law for practical purposes, and only takes a speculative interest in theories of the nature of gravitation.

Possibly the best analogue in physics to Arrhenius's theory of electrolytic dissociation is van der Waals's theory of the continuity of the gaseous and liquid states. Van der Waals's theory can be put in the form of a comparatively simple equation which is very successful in representing the facts in broad general outline, though in many cases it proves to be imperfect in detail. Although the kinetic molecular assumptions on which van der Waals based his theory may be questioned, his equation will remain an important aid to investigation in its special domain until it is superseded by another of comparable simplicity and of greater comprehensiveness.

JAMES WALKER.

The Invention of the Slide Rule.

IN NATURE of January 13 (p. 307) Dr. Alexander Russell, in writing of the invention of the slide rule, says:—"Supporting the latter view is the fact that he (Oughtred) published (1633) his 'Mathematicall Recreations' under the pseudonym of Henry Van Etten." This evidently implies that Oughtred was the author of the said "Mathematicall Recreations," whereas the very title of the work shows that it was a translation, and not an original contribution. It reads:—"Mathematicall Recreations; or a collection of sundrie problemes and experiments in arithmeticke, cosmographie, astronomie, architecture, chimistrie, &c., extracted out of the ancient and moderne philosophers, *now delivered into English tongue* with the examinations, corrections and augmentations by W. Oughtred."

The italics are ours. The translation was made from the French of Henry Van Etten's "Recreation Mathematique, composee de plusieurs problemes, plaisants et facetieux, en fait d'Arithmétique, Geometrie, Mecanique, Optiq.; et autres parties de ces belles Sciences." The accents are missing in the title-page. The work was published in Paris in 1624. The name of Henry Van Etten is indeed a "pseudonym," but it is that of Jean Leurechon (1591–1690), a French Jesuit of uncommon mathematical versatility, and not that of William Oughtred (1574–1660), an English divine of no less uncommon mathematical ability.

BROTHER POTAMIAN.

Manhattan College, New York City, January 27.

Transit of Halley's Comet.

MAY I point out that at the time of the transit of Halley's comet the sun will be above the horizon at the North Cape? The Cape is distant 18° 49′ 20″ from the pole, and the declination of the sun at midnight of May 18 will be 19° 31′ 42″; adding 27′ 22″ for refraction, the sun's altitude at midnight would be 1° 9′ 44″, and the altitude would increase before the first contact, which will take place at 16h. 6m. local time. The Cape rises to a height of 968 feet, and there should be a very fair sporting chance of seeing something of whatever there may be to see during the sixty minutes' duration of the transit.

C. S. TAYLOR.

Banwell Vicarage, Somerset, February 11.

Dangerous Lecture Experiments.

ALTHOUGH it is no part of my duty to teach chemistry, I have on several occasions had to perform an experiment which Mr. Marle quotes (p. 428) as being dangerous, viz. the collection of hydrogen from the action of sodium on water. I can fully endorse his warning. Twice a violent explosion took place; but I found that if the piece of sodium is carefully cleaned so that all its surfaces are bright, and cold water used, the experiment can be carried out in safety. I do not know if these important details have found their way into the practical manuals in use in chemical laboratories. If not, I trust that this experiment is not one that beginners are directed to make.

M. D. HILL.

Eton College, Windsor, February 11.

Aged Tadpoles.

LAST year I reared about five thousand tadpoles, and, dividing them into twenty portions, brought most of them to the frog stage. As they matured, and the numbers became smaller, the survivors were gradually brought together again into a few vessels, finally into one. Of those which were in the tadpole stage in November, none changed to frogs. They died one by one until only two are left. These are quite healthy—active feeders with long tails and hind legs, but no appearance of fore legs. Perhaps some of your readers will be able to say whether it is usual to have tadpoles a year old, and whether one may expect any change to take place now—whether, perhaps, like Axolotl, they may not exhibit the power of reproducing their own kind if they remain alive.

JOHN DON.

Carrick Academy, Maybole, N.B.

SOUTH SEA SAVAGES.[1]

MR. H. W. WALKER, in an account of his wanderings among the savages of Fiji, the Philippines, Papua, and Borneo, has not set himself the task of dealing scientifically with ethnographical details. He has aimed rather at giving a general impression of native life and environment in some of the more out-of-the-way corners of the island world. In this aim he has admirably succeeded, and his book affords a vivid picture of the people and regions which he has endeavoured to describe.

The first chapters recount a visit to Ratu Lala, chief of the Fijian island of Taviuni. Here, under the thin veneer of civilisation produced by two years' schooling at Sydney, was found a man at heart a savage, who could boast of how he treated his jester as a fish and played him with hook and line, or pegged a woman on an ant-hill, smearing her with honey to make the ants bite.

In this and the following chapter on the ex-cannibals of Na Viti Levu, "who would still like to eat man if they got the chance," Mr. Walker describes Fijian dwellings, customs, and war ceremonies.

In the Philippines the author visited Pampanga, in North Luzon. In the mountains near Florida Blanca he stayed with some friendly Negritos, of whose appearance, dress, ornaments, and weapons he gives an interesting account. While staying here Mr. Walker heard of a strange people called Buquils, who lived further in the mountains, and were reported to be Negritos with long smooth hair. The women were said to have beards. Mr. Walker made a difficult mountain journey with his Negrito friends to try to find these people. When almost in touch with the Buquils, however, the Negritos refused to proceed further until they had sufficient fighters to avenge the killing of their fellow-tribesmen who had ventured into the Buquil country. Mr. Walker had to catch his steamer, and could not wait for them.

Mr. Walker next describes his adventures during a Government punitive expedition against the Dobodura tribe in North-east British Papua. Although on the warpath, the author was not unmindful of natural scenes, and gives some interesting notes on plants, birds, and forest scenery. Mankind was less pleasant, and as the party passed along they saw "in each village plenty of human skulls and long sticks with human jawbones hanging upon them." A brisk description is given of the skirmishes and night attack. Once the author was separated from his party, and had some lively anticipations of taking a too prominent part in a cannibal feast. For the Dobodura were cannibals of a very pronounced type, and the author's headings and items in these chapters are suggestive of a ghastly nightmare. "Pigs shot to prevent them from being cooked alive.—Revolting relics of cannibal feast.—Doboduras eat their enemies alive.—Method of extracting the brains.—Man better than pig.—Carriers ask leave to eat one of the slain.—Horrible barbarities of the Doboduras.—Unpleasant anticipations.—Two miners roasted alive." Incidentally, in these chapters Mr. Walker bears witness to the smartness, pluck, and good humour of the native Papuan police. In the same region of Papua, the author, with Messrs. Monckton and Acland, discovered a peculiar tribe of flat-footed lake-dwellers, whom report had credited with webbed feet like a duck. There was some truth in the report, and Mr. Walker gives a description of the people and an account of their customs quoted from Sir F. Winter.

The next chapters relate to the head-hunting Sea

A Negrito Family. From "Wanderings among South Sea Savages," by H. Wilfrid Walker.

[1] "Wanderings among South Sea Savages and in Borneo and the Philippines." By H. Wilfrid Walker. Pp. xvi + 254. (London: Witherby and Co., 1909.) Price 7s. 6d. net.

Dayaks in Sarawak. The author gives interesting notes on Dayaks and heads, and a gruesome story of a head-hunting exploit. Later he lived with Dayaks on the Sarekei River. The chapter in which he describes his life among them is one of the best in his book.

The final chapter is an account of a visit to the famous birds'-nest caves of Gomanton, in British North Borneo. Of these caves and their inhabitants —birds and bats—an interesting account is given. Incidentally also a good word-picture is given of Borneo river and jungle life.

Mr. Walker has told his story in a very natural and entertaining way. There are no dull pages. Some of his cannibal and head-hunting tales may be *horrendum dictu*, but even these are to be matched by facts culled from many an official report on these wild people of the South Seas.

The book is well illustrated by forty-eight illustrations from photographs, and has a useful index.

S. H. R.

THE FRENCH ANTARCTIC EXPEDITION.

THE French expedition under Dr. Jean Charcot, on board the *Pourquoi Pas?* returned to Punta Arenas at the end of last week. The early return of the expedition, some weeks before it was expected, is due to a series of misfortunes which limited the range of the expedition's operations.

It will be remembered that this is the second of Dr. Charcot's Antarctic voyages. In 1903–5, on board the *Français*, he carried out an expedition along the west coast of Graham Land, south of Cape Horn, wintering on Wandel Island, in about 65° S. lat., and continuing the voyage to a point off Alexander I. Land in about 68° S. lat. Apart from the additions made to cartographical knowledge of some of the islands off Graham Land, the expedition was notable for the scientific observations and collections secured in the departments of hydrography, terrestrial magnetism, biology, botany, and geology.

Dr. Charcot's latest expedition was designed to extend the work done in 1903–5. The programme contemplated another cruise among the islands off the west coast of Graham Land, whence it was hoped to continue the voyage westwards in the direction of King Edward VII. Land; it was also proposed to make excursions southwards to investigate the character of the supposed Antarctic continent, and for this purpose the *Pourquoi Pas?* carried a number of specially designed motor sledges. The expedition was liberally subsidised (24,000*l*.) by the French Government, and the ship, a barquentine with an auxiliary engine of 550 h.p., was specially built for the voyage. The French Naval Department, the Paris Museum, and the Prince of Monaco contributed to the scientific equipment, and the scientific staff included, besides Dr. Charcot, who belongs to the medical profession and is an experienced bacteriologist, specialists in hydrography, oceanography and meteorology, tidal and chemical observations, geology and glaciology, natural history, and terrestrial magnetism.

The expedition sailed from Havre in August, 1908, and from Punta Arenas in the following December. Supplies of coal were taken on board at Deception Island (lat. 63° S.), in the South Shetlands, which has become an important rendezvous for whalers. On resuming the voyage the *Pourquoi Pas?* ran aground, and after being re-floated lost her rudder in collision with icebergs. The voyage, however, was continued to Adelaide Island, south of the 67th parallel, and the adjacent coasts were explored for a distance of 120 miles to Alexander I. Land. Being unable to find a safe anchorage, the expedition then returned north and spent the Antarctic winter of last year off Petermann Island, south of the 65th parallel. Though attacked by scurvy and other diseases, the explorers carried out several excursions, and made a careful study of the glaciology of the region. On the return of summer they continued their explorations among the South Shetlands, again visiting Deception Island, and also Bridgman Island (62° S.). The course of the *Pourquoi Pas?* was then directed south and west, and the expedition succeeded in reaching Peter I. Island (lat. 69° S., long. 90° W.). Ultimately the voyage was extended, between the 69th and 71st parallels, to long. 126° W. King Edward VII. Land extends between the 150th and 160th meridians of west longitude.

Graham Land projects northwards from the Antarctic Circle towards Cape Horn as a great tongue of land with numerous adjacent islands. It has been visited by several expeditions, but its connection with the Antarctic continent is still a matter of speculation. Westwards, in the region south of the Pacific Ocean, Cook and Bellingshausen sighted stray patches of land or appearances of land, presumably part of the Antarctic continent, but the continuous coast has never been definitely traced. Geographically, the value of Dr. Charcot's expedition consists in the work he has been able to accomplish in linking up and defining more clearly the character of these stray patches of coast. Exactly what have been the results of the expedition in this connection can only be determined when his charts become available. As on the occasion of his former expedition, the most valuable feature of the results will probably be the scientific data collected respecting the magnetic, meteorological, hydrographical, and geological conditions in the regions south of Cape Horn. Dr Charcot was unable to make use of his motor sledges for penetrating the Antarctic continent.

RADIUM IN DISEASE.

ATTENTION has again been directed to the possibilities of radium as a curative agent by Sir William Ramsay (at the Authors' Club on Monday), and by Sir Lauder Brunton (in the *Lancet*).

The supply of radium available for the treatment of disease is still so limited that the therapeutic usefulness of this agent has not yet been fully determined. No sooner were indications noted of a prospect of relieving cancer by the use of radium than all the radium obtainable was devoted to this purpose; consequently, its action in less serious ailments is still almost unknown.

In the treatment of cancer, radium has usually been employed in the form of crystals of the bromide. These crystals are contained either in a sealed glass tube or in a button with a covering of thin glass, aluminium or mica. Recently the crystals have been spread in a thin layer upon a flat surface and covered with a layer of varnish. Such buttons and spread preparations are suitable for application to the surface of the body. The glass tubes may be inserted into the interior of tumours, or into orifices of the body; thus, they may be placed in the mouth or nose, in the œsophagus (within a rubber tube), in the rectum, or in the cervix uteri.

Of the three types of radiation given off by radium (the alpha, beta, and gamma radiations), the view commonly accepted is that the gamma rays have a selective action, destroying cancer cells while leaving the normal cells of the part intact, while the alpha and

soft beta rays destroy all cells indiscriminately. Means must accordingly be used to prevent the alpha and soft beta rays from reaching the body. A filter consisting of one millimetre thickness of lead is suitable.

As it is risky to send a patient away with a valuable tube of radium crystals within his body, sealed glass tubes of radium emanation have recently been used (*Lancet*, December 11, 1909). They are enclosed in lead tubing one millimetre in thickness. These tubes of emanation do not differ from the crystals in the rays they emit or in their action; there is, however, one important difference; the radio-active strength of the emanation tube decays according to an exponential law in such a way that the strength is reduced to one-half at the end of about four days. Such tubes, of about 10 milligramme strength, may be placed in contact with a cancerous growth (say in the rectum) and allowed to decay *in situ*. At the end of a fortnight they may be removed, as being then too weak to be of further use.

Other methods have been tried in a few cases; thus, dilute solutions of radium bromide have been given by mouth, and water in which radium emanation has been dissolved has been injected subcutaneously.

Coming now to the results obtained, the accounts are very conflicting. Undoubted relief has been obtained in a considerable proportion of the cases; cancerous tumours have diminished in size, and have disappeared altogether in some cases. But some of the earlier cases reported as cured have since been found to relapse; in some cases the growth has recurred in the original situation, while in others cancerous deposits have formed in internal organs. It seems fairly certain that in some cases cancerous growths may be cured in their early stage by radium, but it is not yet justifiable to attempt this unless the patient is so feeble (through heart disease or Bright's disease, for instance) that the removal of the growth by operation could not be undertaken.

When the surgeon has declared a case inoperable, radium (or Röntgen ray) treatment is used as a last resource, and the attempt is usually a desperate one. It is something, then, to be able to report the complete disappearance of malignant growths in some of these cases, even though the final result is not a cure. The local treatment of cancerous growths does nothing to prevent dissemination of the disease in the internal organs, and it is with the idea of achieving this result that attempts have been made to cause radium or its emanation to circulate through the body. In doing so it must be remembered that the alpha radiation is giving out its full energy in the body; and since this radiation possesses about a hundred times as much energy as the beta and gamma radiation together, it is clear that for practical purposes we may disregard the effect of the gamma radiation in this connection. Now, we started with the postulate that the alpha rays are indiscriminately destructive, so that if enough is allowed to circulate in the body to destroy cancer cells, the normal cells of the body will also be destroyed. It must be allowed, however, that the observations upon which this postulate are founded are by no means conclusive, and though there is no doubt that the alpha and soft beta rays destroy normal cells far more readily than is the case with the gamma rays, it may still be true that they too possess some degree of selective action, if the dosage be regulated with sufficient accuracy.

This branch of therapeutics is still in its infancy, and it would be a mistake either to raise delusive hopes because some cancerous growths have been made to disappear under its use or to declare it useless because disappointments are common. One disease, rodent ulcer, is cured by the use of radium in the great majority of cases, only a few rodent ulcers proving refractory to its use. There are, however, other methods of curing rodent ulcer. The further development of this branch of medical science will be watched with great interest.

A SIMPLE METHOD OF ELECTROPLATING.

AT a meeting of the Royal Society of Arts on February 2, a paper by Mr. A. Rosenberg was read upon an improved method of electroplating. Mr. Rosenberg dispenses altogether with the plating bath and all external sources of electricity. The plating is carried out simply by rubbing on a powder moistened with water. The process is really a refinement of the old contact method. It will be remembered that in this process a piece of metal which it is desired to plate upon is immersed in an electrolyte, for example, one containing a silver solution. In contact with this metal a more electropositive one is placed, also dipping into the electrolyte. This metal, usually zinc, passes into solution, and an electric current thereby is generated. The silver is then plated-out upon the less electro-positive metal.

Mr. Rosenberg employs his electro-positive metal in the form of a fine powder, and generally uses magnesium. This is mixed with a metallic salt or with the powdered metal it is desired to plate-out, and ammonium sulphate or other ammonium salt. In order to plate a piece of metal the powder is moistened with water and rubbed over its surface by means of a piece of rag or a brush. By this means adherent and bright deposits are obtained in about one minute, the thickness of the deposit depending upon the time employed and the quantity of powder used.

The magnesium, being strongly electro-positive, reacts with the moist electrolyte, and goes into solution, causing the metal to be plated-out upon the metallic surface which is being rubbed. In other words, each particle of the powdered magnesium may be said to function as a minute anode. One of the difficulties in electroplating is to plate a substance upon itself. It is easy enough when plating has once commenced, say on a spoon, to give it almost any thickness of deposit; but if the spoon is once withdrawn from the bath and used, it cannot be plated further without first stripping off the old deposit. Mr. Rosenberg claims that with his process this difficulty does not occur.

Another great difficulty in electroplating is the cleansing of the article to be plated; the least trace of grease, even that produced by handling, for example, will prevent an even and adherent deposit. Consequently, articles have, as a rule, to be chemically and mechanically cleaned before being put into the plating bath. With the powder, "Galvanit," of Mr. Rosenberg this is not necessary, because the act of rubbing the powder carries out its own cleansing.

The author's object has been to produce a household method of plating. Thus, when the tinning of saucepans is worn out, the householder has only to polish the inside with the moist "tin Galvanit" to re-tin the saucepan. Spoons from which the silver-plating is partly worn can be re-plated. The "nickel Galvanit" can be used for bicycles and so on. Mr. Rosenberg demonstrated the process before the meeting by plating an iron tube with cadmium, a copper tube with nickel, a penny with silver, and a brass tube with tin.

"Galvanit" can also be used for nickel-facing electrotypes. The process is certainly ingenious, and will no doubt be found useful for small work, but it

is hardly likely to enter into competition with ordinary electroplating for large work or for irregular articles. Nor is it likely to be employed in cases where heavy coatings of metal are required, because it would not be an easy matter to rub on sufficiently evenly to obtain uniform and thick deposits. F. M. P.

UNIVERSITY COLLEGE, LONDON.

APPEAL FOR NEW CHEMICAL LABORATORIES.

MANY old students of University College, London, and others familiar with the work done in the chemical department of the college, will be interested in the appeal which has just been made for funds for new chemical laboratories.

The letter which Lord Rosebery has written as Chancellor of the University, and the statement circulated by Sir Henry Roscoe, as chairman of the Equipment and Endowment Fund Chemistry Appeal Committee, serve to bring into high relief the urgent need at University College for improved and more extensive accommodation in its chemical department, both for teaching and research purposes.

While, thanks largely to the generosity of Mr. Carnegie, the University of Manchester has recently become possessed of adequate and modern laboratories, and fine buildings possessing admirable accommodation for chemical science have been erected at South Kensington—to give two examples only—the University College laboratories date from 1871. Yet, despite material disadvantages, splendid work for chemistry has been accomplished in Gower Street under Graham, Williamson, Sir William Ramsay, and others.

In America to mention the need and to state the sum required would ensure its being immediately forthcoming, especially when it can in a sense be regarded as a means of celebrating the completion by Sir William Ramsay of twenty-one years of work at University College. In Germany, again, the State would see to it that so distinguished a chemist was not hampered by want of material or accommodation.

We are hopeful that a ready response to the appeal will be promptly forthcoming, and that very soon the necessary buildings will be in course of erection. The appeal, and Lord Rosebery's letter referring to it, are subjoined.

An Appeal for 70,000l. for the purchase of a Site and the erection of new Chemical Laboratories thereon at University of London, University College.

The chemical laboratories at University College, London, were for the most part built under the direction of the late Prof. Alexander Williamson in the year 1871. From time to time they have been re-fitted and supplemented to meet the demands of the subject and the increasing number of students in the department. It has been impossible in the present buildings of the college to provide the requisite additional accommodation in rooms immediately adjoining the main laboratories. Consequently, at the present time the department is scattered and inconvenient, and neither in planning nor equipment is it adequate for modern chemistry work. The average number of students in the chemical department for the last four sessions has been 261, of whom, on the average, 160 have been students in the junior classes, 68 students in the advanced laboratories, and 33 research students.

During the last four sessions, the college has been compelled to refuse students for want of room, even after making such arrangements as have been possible for the laboratory work of some students elsewhere. The number of those who desire to do research work under Sir William Ramsay and Prof. Collie has also increased to such an extent that additional accommodation is now a matter of urgent necessity.

The lack of adequate accommodation for the department of chemistry at the college has been carefully considered by the University and college authorities, and the conclusion has been arrived at that nothing short of entirely new buildings can meet the necessities of the case, a conclusion confirmed by the Treasury Commissioners at their last inspection of the college, and also by the University inspectors.

The provision of new buildings for the department of chemistry will greatly benefit other branches of university study now hampered for want of room. The space in the present buildings vacated by the department of chemistry will go some way towards supplying the deficiency of space for other subjects.

It was originally proposed to provide the requisite accommodation for chemistry by erecting the north-west wing of the college on the Gower Street frontage, but a more convenient site has been found fronting Gower Place on the north side of the present buildings of the college. This site has a frontage of about 316 feet and an average depth of 66 feet, with a superficial area of about 20,800 feet, and is suitable in every way for the erection of chemical laboratories. The Senate has acquired an option lasting for a short period to buy this site at an agreed price.

The erection of the north-west wing of the college would necessarily be expensive, because it must be built in Portland stone and correspond in elevation with the remainder of the quadrangle of which it would form part, and for these reasons it would not be suitable for chemical laboratories. It is estimated that the cost could not be less than 70,000*l*.

For this sum (70,000*l*.) not only could the freehold of the proposed new site be acquired, but a suitable building for the department of chemistry could also, it is estimated, be erected upon it.

If sufficient money is not immediately forthcoming to complete the whole scheme, the earlier subscriptions will be applied in purchasing the site.

The services to chemical science which have been rendered by Sir William Ramsay, the university professor of general and inorganic chemistry, who has recently completed twenty-one years' work at the college, and the important discoveries that he has made, are generally well known. In addition to these, the number of researches published during the past twenty-two years by members of the staff and students of the chemical department amounts to 331; of these, 72 have been carried out by Sir William Ramsay and collaborators. It is interesting to observe that while the total number of researches published from the department from 1887–1902 was 115, the number issued since 1902, when the laboratories were enlarged, to the present year is already 216.

It is the wish of Sir William Ramsay's friends and of his old students to see his desire for adequate and well-equipped chemical laboratories realised as speedily as possible.

This appeal for 70,000*l*. for new chemical laboratories is therefore made to all who are interested in the advance of chemical science, and also to all who desire to see university teaching in London developed in accordance with its needs.

Donations or subscriptions, which may be paid in instalments, should be sent to the chairman or the treasurer of the new chemical laboratories fund, and addressed to University College, London.

HENRY E. ROSCOE (*Chairman*).

Letter from the Chancellor of the University.

Dalmeny House,
Edinburgh.
January 23, 1910.

I earnestly hope that the friends of the University of London and the admirers of Sir William Ramsay will cooperate to ensure the success of this appeal for 70,000*l*. for an academical necessity.

Should the admirers of Sir William Ramsay alone take the matter up in proportion to their zeal and his merits, there can be no doubt of the necessary fund being raised.

But indeed those who are interested in the well-being of our university, either from their association with it or on high public grounds, will, I am sure, spare no effort to ensure the prompt erection of the chemical laboratories so urgently needed for its work.

ROSEBERY (*Chancellor*).

ASPECTS OF ASTRONOMY.

AT the anniversary meeting of the Royal Astronomical Society on February 11, the gold medal of the society was presented to Prof. Friedrich Küstner, director of the Royal Observatory, Bonn, for his catalogue of stars, his pioneer determination of the aberration constant from motions in the line of sight, and his detection of the variation of latitude. In his address as president of the society, Sir David Gill described the valuable work done by Prof. Küstner in each of these directions. He prefaced his remarks by saying:—

Astronomy in one sense or another appeals to minds of widely different orders. To the mathematician it offers problems of infinite interest; but, as we all know, there have been most distinguished workers in the field of astrodynamics to whom the spectacular glories of the heavens do not appeal—to whom the first sight of an object like Saturn or a great star cluster as viewed through a good telescope brings no thrill, no insatiable desire to see more or to acquire or devise means for so doing. Such men are too apt to regard the art of observing as a mere mechanical operation that is unworthy of their practical study; but they are thus frequently placed in the position of having to employ observations about which they have not the capacity to distinguish between the good and the bad.

There is a larger number of persons who are not wanting in the emotional response to their first telescopic sight of celestial objects; some of these acquire, or are driven to construct, instruments to indulge their awakened curiosity, and not a few of them afterwards do useful work as astronomical observers.

The attributes of the great majority of astronomers lie between these two extremes; but the number of men who possess the true fire and natural capacity for the most refined original research in the field of astrometry is limited. Such men must have an inborn natural mathematical, mechanical, and manipulative aptitude; the critical faculty to discern the possible sources of error to which any class of observations may be liable, with the inventive capacity to devise means for their elimination; and that persistent patience and divine discontent with their own best efforts which alone can lead to the highest and most refined class of work.

NOTES.

THE following telegram from the Paris correspondent of the *Times* appeared in the issue of that journal for February 16:—"Paris, February 15.—According to a communication made yesterday to the Academy of Sciences by M. Lippmann, Mme. Pierre Curie, the widow of M. Pierre Curie, the discoverer of polonium and radium, has at last succeeded in isolating one-tenth of a milligram of polonium. In order to obtain this result, Mme. Curie, working in cooperation with M. Debierne, has had to treat several tons of pitchblende with hot hydrochloric acid. The radio-active properties of polonium turn out to be far greater than those of radium. It decomposes chemically organic bodies with extraordinary rapidity. When it is placed in a vase made of quartz, which is one of the most refractory of substances, it cracks the vessel in a very short time. But a no less distinctive quality of polonium is the comparatively rapid rate at which it disappears. Whereas it takes one thousand years for radium to disappear completely, a particle of polonium loses 50 per cent. of its weight in 140 days. The products of its disintegration are helium and another body, the nature of which has not yet been ascertained, but Mme. Curie and M. Debierne are inclined to believe it to be lead. Its identity, however, will shortly be established, and at the same time science will have had the experimental proof of the transformation of a body which had been believed to be elementary."

WE learn from the Paris correspondent of the *Chemist and Druggist* that the administrative council of the Pasteur Institute has decided to establish a laboratory for the study of radio-activity and its therapeutic applications. This laboratory will adjoin the Oceanographic Institute there. The Pasteur Institute will devote to this object 400,000 francs of the Osiris Legacy. The University of Paris will give the land and find the rest of the money. Mme. Curie will be directress of the physical side of the laboratory, and the other section (researches as to practical applications of radio-therapy) will be under the direction of the Pasteur Institute. On a neighbouring site an extensive institute of chemistry is to be erected at the joint cost of the State, the city of Paris, and the Paris University.

A COMMITTEE has been formed with the view of promoting investigations into the nature and etiology of pellagra, a lethal disease which has become a terrible scourge in some countries of southern Europe and in many tropical or subtropical regions in other parts of the globe. The generally accepted notion is that the disease is caused by damaged maize; Dr. Sambon has, however, brought forward cogent reasons for regarding this theory as inadequate, and has pointed out that the seasonal prevalence and distribution of pellagra are compatible with its being a protozoal disease, which is spread by the agency of blood-sucking insects, probably sand-flies. It is intended to send Dr. Sambon, accompanied by properly qualified assistants, to a pellagrous region to carry on investigations on the etiology of the disease, and for this purpose it is hoped to raise a fund of 1000*l*., towards which several subscriptions have been received, including a sum of 150*l*. from the Colonial Office.

ALL English chemists will join with their German colleagues in offering their congratulations to Prof. Julius Wilhelm Brühl on his sixtieth birthday, which he celebrated on Sunday last. Prof. Brühl's contributions to chemical science range over the whole of the subject. His first paper, on the substitution amido- and phosphido-acids, was published in 1875, and from that year, almost up to the present, his work exhibits an almost unequalled activity. During the last thirty-five years no fewer than ninety papers have been published by this extremely energetic chemist, and it is worthy of note that, with few exceptions, they are a record of his own personal work. A paper published in 1881, on the relations of the physical properties of bodies and their chemical constitution, was the first of a long series of contributions on a part of chemistry in which Brühl stands pre-eminent. Those who were privileged to be present at the lecture he delivered in London in 1905 will remember the excellent summary he gave, in faultless English, of his work on molecular refractivity. One paper, in the domain of pure inorganic chemistry, deserves special mention as illustrating the all-round character of his work. In this research, published in 1895, hydrogen dioxide was first prepared in a pure condition, its formula was for the first time established, and its physical properties determined. Prof. Brühl has very many friends in this country; indeed, it is scarcely too much to say that all who have met him, at the British Association and elsewhere, are his friends. He has a great love for this country, and an unprejudiced respect for the achievements of her men of science. All will be glad to know that he is recovering from the severe illness which has crippled his activity for the last two years, and hope that his renewed health will enable him to add still more to our knowledge of the most difficult and perhaps the most interesting problems in chemical science.

THE first fertilised eggs of the plaice for the hatching season of 1910 were skimmed from the spawning pond of the Port Erin Hatchery on February 14.

THE Dutch Government is reported to have voted the sum of half a million francs for the erection of a new institute of physical and mineral chemistry, to be under the direction of Prof. F. M. Jaeger, of the University of Groningen.

PROF. J. D. VAN DER WAALS, of the University of Amsterdam, has been elected a foreign associate member of the Paris Academy of Sciences. Prof. Van der Waals has been a correspondant of the academy since 1900.

THE French Physical Chemistry Society has elected the following officers for the present year :—President, Prof. G. Urbain, of the University of Paris; vice-president, M. L. Lapicque, of the same university; treasurer, M. A. Brochet; secretary, M. Ch. Marie.

WE note with regret that the *Revue scientifique* announces the deaths of Prof. H. Dufour, professor of experimental physics and meteorology in the University of Lausanne, and of Prof. Karl Gottsche, director of the Hamburg Institute of Mineralogy and Geology.

IT is announced in *Science* that funds have been raised by public subscription for the establishment of an astronomical observatory at Kamuki, Honolulu, to be used in the first instance for observations of Halley's comet. The observatory, however, will be permanent, and under control of the College of Hawaii.

PROF. G. H. F. NUTTALL, F.R.S., Quick professor of biology in the University of Cambridge, has been awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine. The medal is awarded "from time to time to those who have distinguished themselves in research in tropical medicine and allied subjects."

AN International Congress on the Administrative Sciences will be held at Brussels on July 27–31, in the grounds of the International Exhibition. The Secretary to the British committee is Mr. G. Montagu Harris, Caxton House, Westminster, from whom further particulars may be obtained.

THE annual meeting of the British Science Guild will be held at the Mansion House on Friday, March 18, at 4 p.m. Arrangements have been made for the fellows and members of the Guild to dine together at Prince's Hall, Piccadilly, on Friday, May 6. Mr. Haldane, the president of the Guild, will occupy the chair.

A TELEGRAM was received at Utrecht on February 14 from Mr. H. A. Lorentz, stating that his expedition having the object of penetrating into Central New Guinea from the south coast has been entirely successful. Mr. Lorentz reached the snow-capped range which had previously only been perceived dimly from the distance; he has climbed in these Alpine regions, and has discovered glaciers at an altitude of 15,000 feet. One of the last geographical secrets of the tropical regions has thus been opened, and exploration in detail will no doubt follow.

SPEAKING at the dinner of the Physical Society on February 8, Dr. Chree, president of the society, referred to the work of the society and to its increasing activity. The number of papers read before the society has become much larger of recent years, but he thinks there may be some improvement in the presentation of such papers. Generally speaking, there are three ways in which an author may be congratulated :—first, on producing valuable results; secondly, on the form in which they are put; and, thirdly, both author and audience may be congratulated when the reading has been accomplished. Of these three, the second is the most rare. Papers usually consist of 25 per cent. due to the author and 75 per cent. of material that preceded the paper. Authors are apt to neglect the 75 per cent., and to assume that the audience know all about it; also, when any mathematics appears in a paper, the author generally proceeds to put it upon the blackboard. This is not desirable, because a physicist's knowledge of mathematics is usually not good, and mathematical results are frequently not of great value. In some ways it would be better for authors to read each other's papers instead of their own. Dr. Chree also thought it would be of great advantage occasionally if the society could have a general discussion of a subject by a physicist well acquainted with that special branch of knowledge.

IN the January number of *Man* Mr. T. A. Joyce describes a remarkable wooden statue brought by Mr. E. Torday from the Kasai district in West Africa. Up to the present the art of portraiture in the round, so far as Africa is concerned, has been supposed to be confined to ancient Egypt. This specimen, however, shows that the art extended to the Bu-Shongo nation. The present statue, which is evidently a portrait, represents the national hero, Shamba Bolongonga, who is said to have been 93rd in the dynasty of rulers, the ruling king at the present day being 121st. The work is in many ways remarkable, the treatment of the collar bones and the swelling curves of the trunk displaying an attempt at realism which hitherto was supposed to be entirely foreign to the African artist. Mr. Torday, who must have displayed considerable tact and enterprise in acquiring a historical relic of this kind, is to be congratulated on his success and on his liberality in presenting such a valuable specimen to the British Museum.

DR. C. HOSE, in *Travel and Exploration* for February, gives an account of his visit to the warlike Madang tribe, occupying a region in Borneo which has up to the present remained unexplored. These people, on account of their raiding propensities, have been a terror to their neighbours; but the visit of Dr. Hose has resulted in an arrangement which will, it is hoped, put a stop to this constant intertribal warfare. It is remarkable that this race judge the fitting season for planting their rice by the sun, and they have invented a curious mode of measuring time. This is a sort of gnomon, consisting of a post about a fathom high, a piece of string weighted at each end and thrown over the top showing when the post is perfectly straight. The length of the shadow is measured by a stick marked with notches gradually approaching one another as they recede from the pole. Having got so far, it may be asked why they have never invented the sun-dial. Dr. Hose explains this by the fact that the present instrument is more efficient, as in these latitudes there are many days near each equinox when a sun-dial would be useless.

AMONG the contents of No. 1 of the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg* for 1910 is an illustrated paper, by Mr. E. Nasonow, on the life-history and transformations of *Kermes quercus*.

THE sea-bass (Serranidæ) of Japan form the subject of an article, by Messrs. D. S. Jordan and R. E. Richardson, published as No. 1714 of the Proceedings of the U.S. National Museum. A new species of the large genus Epinephelus is described.

We are indebted to the authors, the Rev. C. E. Y. Kendall and Messrs. J. D. Dean and W. M. Rankin, for a copy of a paper on the geographical distribution of molluscs in South Lonsdale, reprinted from the *Yorkshire Naturalist* for last year. The dependence of the distribution of the various species on station, geological formation, &c., is fully indicated.

In the Proceedings of the Academy of Natural Sciences of Philadelphia for November, 1909, Messrs. H. A. Pilsbry and J. H. Ferriss continue their account of the land and fresh-water molluscs of the south-western States, dealing in this instance with the fauna of the Huachuca Mountains of Arizona. In the same issue Dr. Pilsbry, this time in association with Mr. A. A. Hinkley, discusses the Melaniidæ of the Panuco River system of Mexico.

Three Continental insects are added to the British fauna in the *Entomologist's Monthly Magazine* for February, Dr. D. Sharp recording the Mediterranean beetle *Crepidodera impressa* from Hayling Island and *Galerucella pusilla* from the New Forest and elsewhere, while Mr. E. A. Butler chronicles the occurrence of an example of *Cyrtorhinus geminus*, a Scandinavian and Livonian hemipterid, at Broxbourne, and also mentions a second British specimen of the same species preserved in his own collection.

The January number of the *Museums Journal* contains a summary of the correspondence which has recently appeared in the *Times* with regard to the administration of the natural-history branch of the British Museum. At the conclusion of the summary the opinion is editorially expressed that the director of the natural-history departments should be independent of the director and principal librarian at Bloomsbury. If the separation of the two establishments were carried out, no one, so far as we are aware, has suggested a suitable and adequate title for the one at South Kensington. "Natural History Museum" is obviously insufficient, except when used in connection with this country alone.

At the commencement of a monographic revision of the Strepsiptera, published as Bulletin No. 66 of the U.S. National Museum, Mr. W. D. Pierce states that he is unable to accept the view that these parasitic insects are modified representatives of the Coleoptera, and accordingly regards them as forming an order by themselves, of which several families, in addition to the typical Stylopidæ, are recognised. In the author's opinion, the Strepsiptera form an order, "on a distinct line of descent from that of the Coleoptera, and nearer the Hymenoptera and Diptera, and as highly specialised as the highest insects in any of the orders." It is remarked that few persons have seen the adult winged males of these insects, although most collectors have marvelled at their portraits in books. The author hopes that the publication of his monograph will lead to a considerable increase in our knowledge of these insects.

To *Spolia Zeylanica* for December, 1909, vol. vi., p. 108, Dr. A. Willey contributes notes on the nest, eggs, and larvæ of the well-known fish *Ophiocephalus striatus*, locally termed in Ceylon the lula, or marral. The most interesting fact in connection with the breeding-habits of this fish is that the eggs float on the surface of the water by their own buoyancy, a feature apparently unique among fresh-water species. In certain other groups the same advantages, namely, proximity to atmospheric air and exposure to sunlight, are partly gained by the suspension of the eggs to plant-stems, their enclosure in floating nests of herbage or foam, or by their deposition in very shallow water. As regards development, the simple ventral flexure of the embryo of Ophiocephalus, the absence of retinal pigment within the egg, and the formation of the pectoral fins after the larva is hatched, are features contrasting with what prevails among many teleosteans. In these the later appearance of the ventral fins is the rule. In the African and American lung-fishes the two pairs of limbs arise simultaneously, but in the Australian Ceratodus the ventrals appear about a month later than the pectorals, much as in Ophiocephalus.

We heartily welcome another of those meritorious monographs which the Americans are working up so thoroughly with reference to their own fauna. This time it is a "Monograph of the West American Pyramidellid Molluscks," by W. H. Dall and P. Bartsch (Smithsonian Institution, 1909, Bulletin No. 68). Though titularly devoted to the Pacific coast of the U.S.A., this work will be invaluable to all students of marine gastropods on account of its synopsis of genera and sections, forming a complete key to the systematisation of a most difficult family. It matters very little whether we accept the authors' views as to the status of their subgenera and sections or prefer to regard the majority of them as genera. Certainly many, such as Syrnola, Actæopyramis, Mormula, and Menestho, are generally nowadays accorded the higher rank—no doubt in course of time practically all their groups will be so treated. Meanwhile, Messrs. Dall and Bartsch prefer to restrict the number of recent genera, and admit only three of the four to be found in Fischer's "Manuel de Conchyliologie," Eulimella being subordinated to Pyramidella; the latter has altogether twenty-three named subdivisions, Turbonilla has twenty-four, and Odostomia has forty. So far as concerns our British Pyramidellids, the classification coincides mainly with that adopted in the Conchological Society's latest list (*Jour. of Conch.*, 1901). We note, however, several changes. The names Ondina and Pyrgostelis yield in priority to Evalea and Pyrgiscus, and the latter group, typified by the old *Odostomia rufa*, Phil., is transferred—we think more conveniently and correctly—to Turbonilla. A similar transfer is made of *O. fenestrata*, Forbes, and it is placed in a separate subgenus, Tragula. Pyrgulina is reserved for species with a sculpture of impressed spiral lines, and for our species of the *interstincta* type we must substitute the name Parthenina.

The latest and concluding number of the ninth volume of the *Bulletin du Jardin Impérial botanique*, St. Petersburg, contains a note, by Mr. J. W. Palibin, relating to the distribution of *Adoxa Moschatellina* in the Caucasus and *Ruppia maritima* in south-eastern Siberia, and an article by Mr. A. A. Elenkin in which he presents a survey of certain species of Anabæna, with special reference to a new species, *Anabaena Scheremetiewi*.

A second contribution of notes on Philippine palms, by Dr. O. Beccari, is published in the botanical section (vol. iv., No. 5) of the *Philippine Journal of Science*. The type of a new species, *Normanbya Merrillii*, is provided by a fine palm which has the habit of *Areca catechu*, and yields a nut suitable for chewing; another new species, *Areca macrocarpa*, also bears comparison with the Areca palm on account of its fruit, which is even larger than the betel-nut. Several new species are placed in the genera Livistona, Korthalsia, Heterospathe, and Pinanga; there are also additions to the climbing palms Calamus and Dæmonorops. The same number of the journal contains a first article, by Mr. O. Ames, on Philippine orchids, and a revision of the native Combretaceæ by Mr. E. D. Merrill.

THE useful and general nature of the work carried on in the West Indies under the direction of the Imperial Department of Agriculture is well exemplified in the report presented by the curator of the botanic and experiment stations in the small island of Montserrat. Experiments have been instituted in connection with the important lime-fruit industry to see what results are attained by clean cultivation. The welfare of the peasants receives attention by the provision of help and guidance in cotton cultivation and by the introduction of improved varieties of tannias and cassava, which form a staple article of food. Further, the possibilities of new products are being put to the test in the experimental plots of the wild bay tree *Pimenta acris*, lemon grasses, and *Pilocarpus racemosus*; the two former yield essential oils, while the latter is a source of the drug pilocarpine.

WITH the object of obtaining information regarding the geotropic sensibilities of stalked Basidiomycetes, Dr. F. Knoll carried out a series of experiments with *Coprinus stiriacus*, which he describes in *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxviii., part v.). A study of the longitudinal growth shows that there is a growing region at the top of the stipe or fruiting stalk where intercalary growth, due entirely to extension of the separate hyphæ, takes place. The stipes, which in the very earliest stage are ageotropic, become later negatively geotropic. Perception of the stimulus and power of response are manifested by the whole of the growing region. The variation noted in the "reaction-period" is remarkable; while the pileus or cap is young an interval of two hours may elapse between the stimulus and response, but when the spores are ripe this period decreases to a few minutes.

DR. EMIL WERTH contributes an account of the surface features of Kerguelen Island to the *Zeitschrift* of the Berlin Geographical Society. The paper is, to some extent, an abstract of the author's more complete memoir on Kerguelen published in the report of the German South Polar Expedition, 1901–3; it gives an account of the topography of the island, and discusses its relation to volcanic phenomena, past and present glaciation, and rock weathering.

THE December (1909) number of the Bulletin of the American Geographical Society contains an account of some experiments on the artificial formation of deltas, carried out in the laboratory of the geological department of Ohio State University, by Mr. Arthur L. Smith. The experiments produced two general forms of deltas, one with regularly semi-circular outline and one with irregularly lobate outline. It was found that the ultimate form of the first was determined by the maintenance of a constant or increasing stream gradient, and of the second by the decrease of the gradient of the stream. Pronounced cross-bedding was found to occur only in the fore-set layers of the lobate form, and, to a small extent, in all top-set beds. Experiment confirmed the impression, conveyed by an examination of maps of natural deltas, that "fingers" are merely surface features of the delta margin. The shape of a delta is unaffected by the depth of water or irregularities in the bed on which it is formed.

THE Kelvingrove Museum in Glasgow, which belongs to the Glasgow Corporation, contains a valuable collection of minerals, including the Glen collection, purchased in 1896, and the Fleming collection, presented in 1902. The museum is rich in the interesting minerals that have been found in the estuary of the Clyde and at other localities in western Scotland. A useful guide to the minerals in this museum has been written by Mr. P. MacNair, the curator of the natural-history collections (Glasgow: Robert Anderson, 1910, price 3*d*.). More than half the work is taken up with an introduction to mineralogy, which is more technical and advanced in its treatment than corresponding guides issued by other museums. It endeavours to carry the reader farther into the details of crystallography than most visitors to an English museum would care to follow, and the index includes many names of little importance; thus in P are Paulite, Pissophanite, Plinthite, and Protheite. The guide concludes with a brief account of the chief mineral species. It is illustrated by a plate of the interesting calcite pseudomorphs, attributed to Gaylussite, that have been dredged from the Clyde estuary.

STATISTICS of aëronautical patents in recent years are given by Dr. W. A. Dyes in the *Zeitschrift für Luftschiffahrt* for February. The number of complete patents granted in Germany was 73 in 1909, 36 in 1908, 27 in 1907, 14 in 1906. The corresponding numbers of provisional protections were 140, 48, 37, 14. In view of the fact that in Germany applications for patents are not published until the Patent Office has examined their validity, the author gives for comparison the number of applications filed by the English Patent Office in the same years, namely, 776 in 1909, 224 in 1908, 189 in 1907, 43 in 1906, and 19 in 1905.

No better illustration of German progress in aërial navigation could be found than the long list of local aëronautical societies the official notices of which appear in the German *Zeitschrift für Luftschiffahrt*. In addition to the German Luftschiffer Verband, we have "Vereine für Luftschiffahrt" for the following districts:—Berlin, Central Rhenish, Lower Rhenish (sections at Bonn, Düsseldorf, Krefeld, Essen, Wupperthal), Pomeranian, Bremen, Bitterfeld, Lower Saxon, Brunswick, Hamburg, Saxo-Thuringian (with sections for Thuringian States, Erfurt, and Halle), Breisgau, Frankfurt, Anhalt. The Imperial Aëro Club also occurs in this list, which is based on the February number. We have nothing to correspond with these local societies in England. It must, however, be admitted that the hideous and gruesome illustration of "The Aëronaut's Death" in the January number of the *Deutsche Zeitschrift* is a little out of place in a scientific journal.

DR. F. W. EDRIDGE-GREEN read a paper on colour-blindness at the Royal Society of Arts on February 9. The paper is an excellent and lucid exposition of his well-known views upon the subject, and as such it will well repay perusal. In its general character his theory is one which is attractive to physiologists, but some of his assumptions require more impeccable evidence than is adduced. We may cite as an example the statement that "the decomposition of the visual purple by light chemically stimulates the ends of the cones (very probably through the electricity which is produced)." His strictures of the tests for colour-blindness in common use have at least sufficient foundation to demonstrate the need for their reconsideration as a part of the reformation of the official examinations.

THE November (1909) number of the Bulletin of the Bureau of Standards contains a paper, of nearly fifty pages, on platinum resistance thermometry at high temperatures, by Messrs. C. W. Waidner and G. K. Burgess. They find that temperatures determined on the pure

platinum resistance scale standardised at 0°, 100°, and at the boiling point of sulphur, taken as 444·70° C., agree with temperatures on the gas thermometer scale in the interval 0° to 1100° C. within the limits of experimental error of the latter scale. With impure platinum, for which the constant δ of Prof. Callendar's interpolation formula differs from 1·5, the value of δ has to be taken as increasing with temperature by an amount which increases with the degree of impurity before agreement with the gas scale can be secured. With the pure palladium thermometer even this is not sufficient. In neither case is the interpolation formula proposed by Mr. J. D. H. Dickson found suitable. High temperature appears to render the impure platinum purer, possibly by evaporating impurities, as, for example, iridium. The authors consider it desirable that thermometers should be standardised at a fourth point in addition to the three mentioned above, and suggest that the freezing points of metals, even when only commercially pure, are now known with sufficient accuracy, and are so easily reproduced, that they furnish convenient fixed temperatures. They give the following figures for the freezing points:—tin, 231·92°; cadmium, 321·01°; lead, 327·43°; zinc, 419·37°; antimony, 630·71°; aluminium, 658·0°; silver, 960·9°; copper, 1083·0°; the 72 per cent. silver, 28 per cent. copper eutectic, 779·20°.

H.M.S. *Collingwood*, the latest of our Dreadnought battleships, has just completed her official steam, gunnery, and torpedo trials, a brief account of which appears in the *Engineer* for February 11. The *Collingwood* is the sixth ship of her class floated, and was launched from Devonport Dockyard on November 7, 1908. The machinery is of the Parsons turbine type, and there are two complete sets, each set comprising one high-pressure ahead and one high-pressure astern turbine; one low-pressure ahead turbine, in which is incorporated one low-pressure astern turbine and one cruising turbine. The boilers are of the latest improved large-tube Yarrow type, adapted for either coal or oil fuel. During the speed trials the powers specified were easily exceeded, and although the sea was very rough while the battleship was run over the measured mile at Polperro, the designed speed of 21 knots and the specified shaft-horse-power of 24,500 was realised. Other trials included 30-hour runs at 20 and 70 per cent. of the full power, and eight hours at full power. The machinery was constructed by Messrs. R. and W. Hawthorn Leslie and Co., Ltd., the order having been promptly executed despite seven months' lost time during the engineers' strike on the north-east coast.

THE first part of a general description of the engineering and constructional features of the Panama Canal, by Mr. G. W. Goethals, chairman and chief engineer of the Isthmian Canal Commission, appears in *Engineering* for February 11. Among other interesting items, we learn that dynamite is used for blasting, as excessive moisture and water in the holes prevent the use of blasting powder. An average of 1,000,000 lb. of dynamite per month is consumed for the entire work, and the number of accidents has been relatively small, although, owing to the number of men in contracted areas, the casualties have been great. Premature explosions, attributable to concussion during loading, led to the substitution of pine-rammers for those of lignum vitæ. Temperature tests are made prior to loading, as in some cases high temperatures exist in the holes. Unexploded charges, subsequently dug out by steam shovels, led to laying wires direct from electric-lighting plants to the cut in substitution for the ordinary magneto-electric machines operated by hand. The fuses are connected in parallel in lieu of in series, failures often occurring in the latter case, none in the former. No holes are now loaded which cannot be fired the same day, a precaution necessitated by the premature explosion of 22 tons of 45 per cent. dynamite at Bas Obispo, probably owing to some of the nitroglycerine having been liberated and exploded by concussion by a dobie shot in the vicinity. Accidents have occurred during electric storms, and the only possible precaution is now taken by stopping work.

THE evidence given at the Board of Trade inquiry into the Stoat's Nest accident on the London, Brighton and South Coast Railway shows that the left-hand leading wheel of the coach which left the metals had been displaced from its true position on the axle by about one inch. This would be quite sufficient to cause an accident if the wheel had previously shifted, and there is reason to believe that this was the case, as the signalman had seen sparks flying from the bogie frame near this wheel before the accident occurred. Commenting on the evidence, *Engineering* for February 4 points out that in many cases too much reliance is put on the men in charge of the work of pressing wheels on to the axles. A great deal of care is taken by the railway companies, and only experienced men are chosen for this work; but the foremen cannot witness every operation, and there may be a tendency for workmen to pass wheels which have been pressed on at figures barely reaching the required limit. The pressure used in the case of the wheel above mentioned was stated in evidence as sixty tons. It is of interest to note that, at the Horwich works of the Lancashire and Yorkshire Railway, an autographic record is drawn by the press during each operation. Such a record is invaluable as a check on the workmen, and enables the foreman to deal promptly with cases of poor work before the wheels leave the shop. The *Engineer* for February 4, commenting on the accident, says that facing points as now constructed are not dangerous, and that diamond crossings are a source of danger. It is suggested that the accident may have been caused by the wheel, which was wide to gauge, striking the diamond crossing which exists at the place where the accident occurred.

PROF. W. H. HUSSEY contributes to the January Bulletin of the American Mathematical Society tables of Galois fields of order less than 1000.

IN the *Rendiconto* of the Naples Academy (3), xv., 3, 4, Dr. Paolo Rossi discusses the nature of the secondary radiations of X-rays and their dependence on the substance which emits them. A property is referred to, analogous in some respects to Stokes's law of fluorescence.

MESSRS. HOEPLI, of Milan, have issued the fifth and last volume of Brioschi's collected mathematical works, at the price of 30 francs. This volume contains papers contributed to French, German, and English mathematical and scientific journals.

MESSRS. JOHN WHELDON AND CO., of 38 Great Queen Street, Kingsway, London, have issued a classified entomological catalogue, comprising some 1400 books and papers they have on sale. We notice that the list includes some recent purchases and selections from various entomological libraries.

THE ten numbers of the "Bulletin of Miscellaneous Information," issued during 1909 from the Royal Botanic Gardens, Kew, and noticed already from time to time in NATURE, have been published in volume form. Like other Government publications, the book may be obtained, directly or through any bookseller, from Messrs. Wyman and Sons, Ltd., Fetter Lane, London. Its price is 3s. 6d.

A SECOND edition of Prof. Wilhelm Ostwald's "Grosse Männer" has been published by the Akademische Verlagsgesellschaft of Leipzig. It will be remembered that the first edition of the work was reviewed at length in our issue of July 29, 1909 (vol. lxxxi., p. 121). The price of the volume is 14 marks.

OUR ASTRONOMICAL COLUMN.

COMET 1910*a*.—Reports received from various observers show that at the beginning of this week comet 1910*a* was no longer a striking naked-eye spectacle, and there is little that is new to record regarding it.

Mr. Gustave Gillman sends us a fine drawing showing the comet's position and the extent of its tail as seen by him at Aguilas, Murcia, Spain, on January 27 and 31. For the former date the drawing, which is a large-scale chart of the region of stars wherein the comet was then located, shows, distinctly, the tail extending to ζ Pegasi, making its length more than 20°; but unfortunately the chart is unsuitable for reproduction here.

In *La Nature* for January 29 (No. 1914) M. Lucien Rudaux describes the comet as seen from Paris on January 21 and the succeeding days, and a drawing shows that it had a brilliant nucleus and a well-developed tail, several degrees long, on January 22. A number of observations are also recorded in the *Gazette astronomique* (No. 26), where attention is directed to the fact that if the apparent length of the tail on January 30 were 30°, the actual length was something like 110 million kilometres (68·75 million miles).

A number of drawings and photographs of the comet were shown at the meeting of the Royal Astronomical Society held on February 11. Among other remarkable features were the development of a shorter tail on the southern edge of the main tail, near the head, and the considerable extension of the main tail at its N.E. extremity; this extension curved quite abruptly from the main axis, and reached nearly to γ Pegasi. Mr. Hinks, who showed a number of drawings, directed attention to the fact that the bright nucleus was situated on the extreme inner edge of the head, so that the two branches of the tail appeared to enwrap it completely on the sunward side. The drawings also depicted the zodiacal light, with which the tail appeared to merge, thus forming a magnificent spectacle. Observations are also recorded in No. 6 of the *Comptes rendus* (February 7). MM. Luizet and Guillaume state that on January 29 and 30 the tail was 30° long, and, at a distance of 15° from the nucleus, its breadth was 2°; on January 31 it was distinctly fainter. MM. Javelle, Charlois, and Schaumasse report that on January 25 the nucleus was round and 10″ in diameter, and two aigrettes, symmetrical with regard to it, were distinctly seen. On February 1 the comet was sensibly fainter, and the aigrettes were no longer visible, whilst a further diminution of brightness was recorded on February 2, and the nucleus was seen to be elongated. M. Borrelly records that on February 3 the side of nucleus nearer the sun was nearly devoid of coma.

THE MAGNETIC STORM OF SEPTEMBER, 1909, AND SOLAR PHENOMENA.—The connection between the magnetic storm of September 25, 1909, and the contemporaneous solar phenomena observed at the Meudon Observatory is discussed by M. Deslandres in a paper which appears in No. 2 of the *Comptes rendus*. A spectroheliogram of the upper hydrogen atmosphere, on September 24 4h. 35m. p.m., shows strong dark *filaments* connected with the spots, the areas of the latter being greatly diminished. At 9h. 3m. a.m. on September 25 these *filaments* had nearly disappeared, and were broken up, and M. Deslandres connects this phenomenon with that of the magnetic storm. A photograph of the "mean layer" of calcium on September 24 shows the eastern spot to be bordered, on its eastern side, with alternate bright and dark filaments, polygonal in form and sharply defined, and a number of similarly shaped flocculi join the two spots. M. Deslandres names this special structure *le réseau chromospherique*, and supposes that it shows the region on the western side of the spot to be in a fairly calm state. Photographs taken for that purpose, on September 24, give no evidence of motion in the line-of-sight, but show the bright vapours above the eastern spot discussed by Dr. Lockyer.

M. Deslandres discusses the several theories as to the solar-terrestrial connection, and shows that the "kathode radiation" theory may explain many of the phenomena. The kathode rays leaving the spot are curved, by the exterior magnetic field of the sun, like the spires of nebulæ, and this may account for the mean "lag" of forty-five hours between the meridian-transit of the spot and the incidence of the magnetic storm. The "whirls" of Prof. Hale thus become the effect, rather than the cause, of the magnetic field, which by M. Deslandres's theory is produced by the corpuscles circulating round the sun with great velocities. The difference between the calcium and hydrogen images is also explained by this theory, for the action of the field would produce different results on atoms of different masses.

THE INTRINSIC LIGHT OF THE SKY.—An interesting method of comparing the intrinsic light of various parts of the sky *inter se* and with stars of known magnitude is described by M. Ch. Fabry in a paper appearing in No. 5 of the *Comptes rendus* (January 31, p. 272).

In the focal plane of an objective of 48 cm. focal length M. Fabry placed a circular diaphragm of variable aperture. Passing through this aperture, the light of the sky fell upon an optical system, of 3·15 cm. focal length and large aperture, which projected an image of the objective on to a photographic plate. Thus the plate registers, as a uniformly illuminated circular area, the whole of the light coming from that part of the sky of which the image is formed behind the diaphragm. In making a determination, two exposures are necessary:—(1) the camera is directed to a star, *e.g.* Polaris, and the diaphragm is closed down so that only the light from the star is allowed to reach the plate; (2) the camera is directed to the region of the sky to be investigated, and the diaphragm opened so that an exposure of equal duration will give an image of equal density to that produced in the first case; a simple calculation then gives the ratio between the intrinsic illumination of the area under consideration and the light of the chosen star.

By this method M. Fabry finds that a square degree of sky, in galactic latitude 30° and near the pole, gives a photographic intensity equal to 0·103 that of Polaris, or 0·92 that of a fifth-magnitude star. The corresponding ratios for an area, of one degree square, between β and γ Cygnus, one of the brightest regions of the Milky Way, are 0·212 and 1·9 respectively. These values differ from those obtained by visual observations, probably because the magnitude of Polaris was taken as 2·62, but if the visual magnitude of the latter is taken, 2·12 on the Harvard scale, the result for 1 square degree of non-galactic sky is 1·46 of a fifth-magnitude star, a value intermediate between those obtained by Newcomb (1·15) and Burns (2·0). As regards the ratio between galactic and non-galactic sky, M. Fabry's results are in accord with the visual observations.

ELLIPTIC ELEMENTS AND AN EPHEMERIS FOR DANIEL'S COMET, 1909*e*.—From observations made at Rome and Nice on 1909 December 8 and 1910 January 2 and 14, Dr. Ebell has calculated elliptic elements for the orbit of Daniel's comet, 1909*e*, which he publishes, with an ephemeris, in No. 4384 of the *Astronomische Nachrichten* (p. 264). The elements give 1909 November 28·91228 (Berlin) as the time of perihelion passage, and 6·403 years as the period, but they are not yet considered final. According to the ephemeris, the comet is now (February 17) 58m. east and 38′ north of δ Aurigæ, and is only about one-fifth as bright as it was on December 8; its daily motion is slightly less than 2m. nearly due east.

PUBLICATIONS OF THE LUND OBSERVATORY, SWEDEN.—From the Lund Observatory, Sweden, we have received three papers, published as *Meddelanden från Lunds Astronomiska Observatorium*. No. 5 (series ii.) is by Prof. Charlier, and discusses the motions of the orbit-planes of satellites in various planetary systems. In No. 6 M. Henrik Block discusses a class of singularities in the problem of n bodies, and in No. 40 (first series) Dr. Zinner treats of the secular perturbations in the planetary rotation problem.

IMPROVEMENTS IN RESILIENT WHEELS FOR VEHICLES.

AT a meeting of the Royal Society of Arts held last December, the Hon. R. Clere Parsons gave a brief history of the improvements which had been made from time to time in the wheels of vehicles, which had resulted in the extensive adoption of the pneumatic tyre, and then passed on to describe a spring wheel which possesses practically all the advantages of a pneumatic-tyred wheel without its heavy cost of maintenance and liability to puncture.

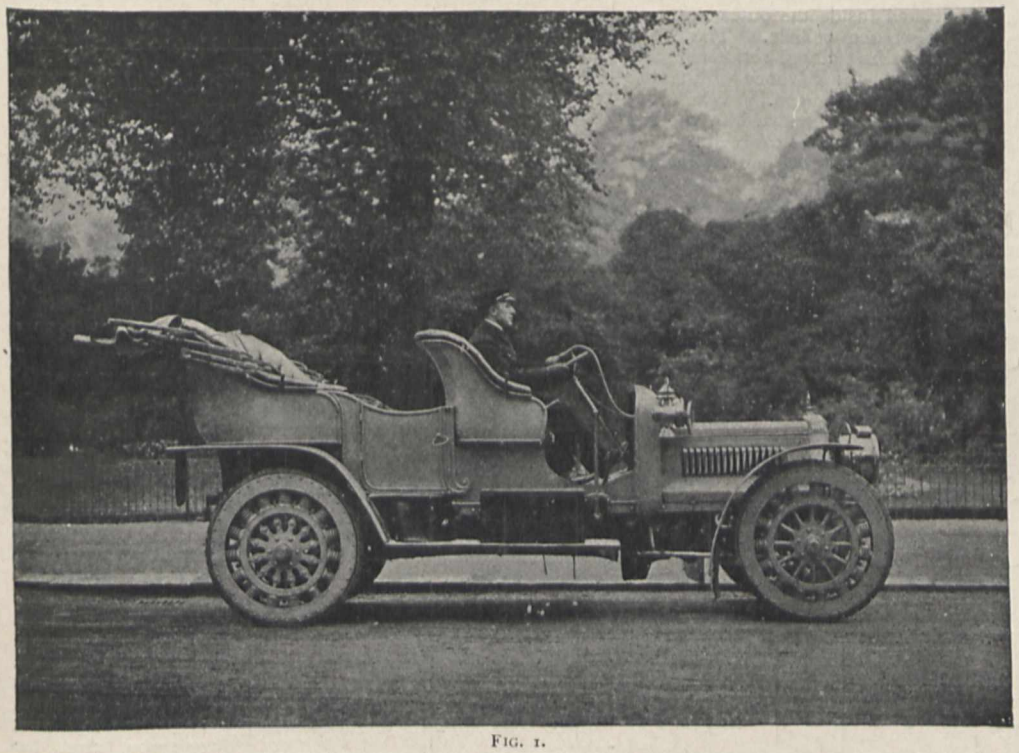

FIG. 1.

The author explained that, before he attempted to design a spring wheel, he had made a careful search through the records of the British Patent Office Library with the view of ascertaining, if possible, why the numerous inventions relating to this question had not been successful. This search led him to believe that if certain principles were adopted, and careful investigations made, there was a prospect of obtaining a trustworthy spring wheel, which as yet had not been produced.

The preliminary investigations were made with model wheels 12 inches in diameter, which were tested in the apparatus he described, and in which the effects of the jolts imparted to the wheel were automatically recorded. The result of these investigations indicated that it was possible to substitute spiral steel springs for the air spring of the pneumatic tyre, and at the same time retain practically all its resilient properties.

This special type of wheel, which is known as the "Panflex," from its being flexible in all directions, was then carefully designed, and a set fitted to a 28–36 horse-power Daimler touring car, illustrated in Fig. 1, which in running order weighed 2 tons 5 cwt.

The wheel, illustrated in section and elevation in Figs. 2 and 3, consists of a steel channel rim similar to those used for solid rubber tyres, and into which a rubber tyre is inserted. On each side of this channel rim are rivetted annular plates, so as to form an internal channel, in the bottom of which are corrugated transverse projections. To the wheel centre are rigidly fixed spiral springs at regular intervals, which project radially outwards, and to their extremities are attached rubber pads formed with transverse undulations. The

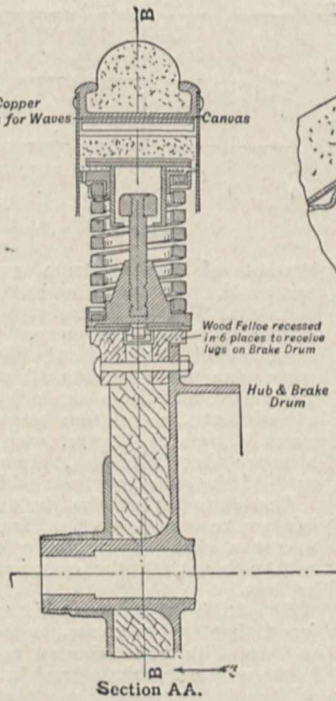

FIG. 2.

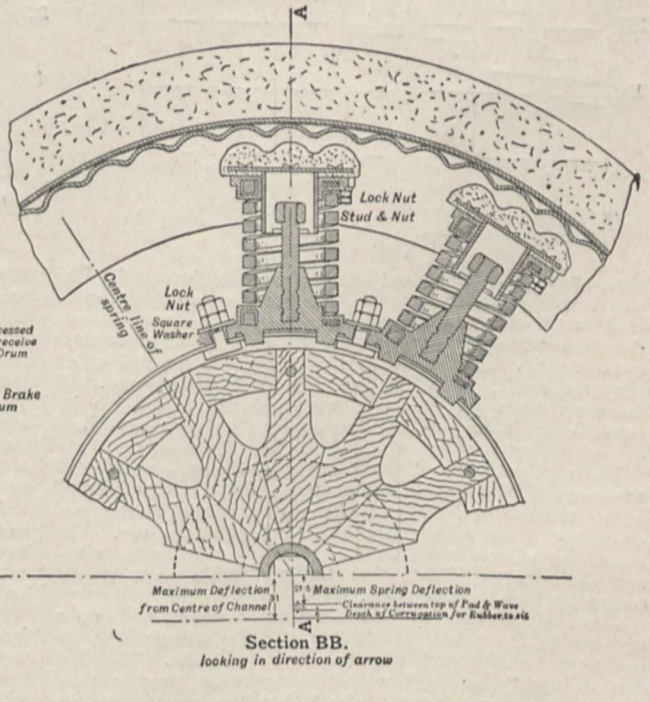

FIG. 3.

diameter of the wheel centre over the pads of the springs being slightly less than that of the channel rim, the wheel centre can be inserted therein, but is not connected in any way with it. The wheel is then complete and ready to be used on a vehicle.

The action of these wheels is simple, and merely consists of the pads on the ends of the spiral springs, as it were, acting as feet, which walk round inside the outer rim, and in turn support the weight of the vehicle. The wheel centre, when the vehicle is travelling along, rotates slightly more rapidly than the outer rim, the advance of the one upon the other being termed the "creep." When any obstacles are passed over, the shocks imparted to the rim of the wheel, which would, if it were a solid one, be transmitted through the axle to the machinery and car body, are absorbed by the rubber pads and springs before they reach the wheel centre. The principle and details of this wheel are quite novel, as has been admitted by the German Patent Office experts previous to granting the patent.

Owing to the rubber caps at the extremities of the spiral springs being capable of deflecting in all directions within certain limits, the friction of the moving parts of the wheel is negligible, and, as a result, practically no heating occurs, consequently the wear and tear is exceedingly small. The spiral springs attached to the wheel centre are designed so that in no case can they be subjected to a strain in any direction whichever approaches their limit of elasticity; consequently, provided no flaw exists in the steel of which they are made, their life should be indefinitely long. If, however, from any cause a spring should break, no inconvenience is felt, as the journey can be completed, and a fresh spring can then be fitted in about five minutes.

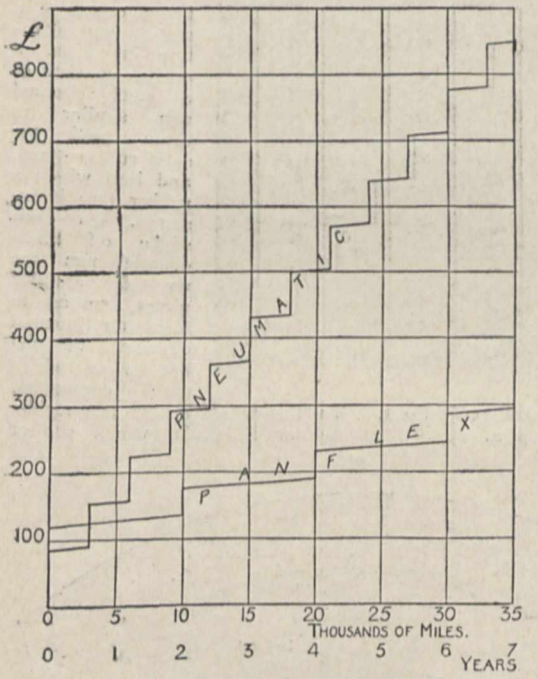

FIG. 4.

The repairs of the "Panflex" wheel merely consist of the renewal of the solid rubber tyre, which can be effected by a coach-builder, and probably an occasional rubber pad or spring, a few of which should be kept in the car. The wheels have been tested on the Daimler car for 4000 miles, and the results indicate that the perishable parts should endure at least 10,000 miles.

These wheels have also undergone very severe tests on a taxi-cab in the streets of London and the suburbs for the last three months with very satisfactory results. The first cost of the "Panflex" wheel is somewhat greater than that of a pneumatic-tyred wheel, but the expenditure on maintenance is much less, as is shown by the diagram exhibited by the author (Figs. 4 and 5), which indicates the saving in maintenance of each car, as regards tyres, by the use of "Panflex" wheels.

In conclusion, the author enumerated the advantages possessed by the "Panflex" wheel, and explained that by its adoption the use of the motor-car could be brought within the reach of persons who are now precluded from availing themselves of it owing to the excessive cost of maintenance of the tyres.

THE SPECTRUM OF THE ZODIACAL LIGHT.

SINCE the time when Cassini published his observations of the Zodiacal Light, in 1682, the question as to the nature and origin of this peculiar phenomenon has been constantly recurring. Visual observers were ever at variance on the subject, some holding the view that the Light was a terrestrial adjunct, others that it was a solar appendage. Visually, the matter is a difficult one to decide, for no optical power may be used because of the lack of contrast between the Light and its background of sky. Photography is similarly placed out of court, but it was expected that the question would be solved by the spectroscope. This expectation has never yet been realised absolutely, but the results recently published (Lick Observatory Bulletin, No. 165) by Dr. Fath clarify matters considerably.

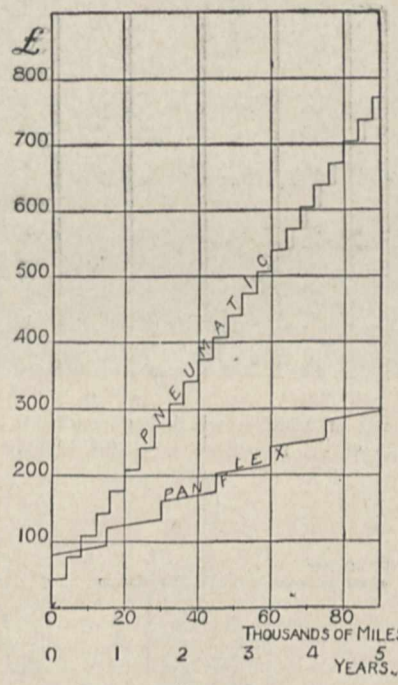

FIG. 5.

Previous spectroscopic observations have varied on a vital point, viz. the presence or absence of bright radiations in the spectrum, indicating, by their presence, that the Light was self-luminous. Thus some observers found that the spectrum was continuous, others found that its continuity was broken by bright bands, especially the bright aurora line at λ 5571. The argument for the presence of the latter as an inherent element of the spectrum was, however, considerably weakened, if not eliminated, by the observations of Respighi, Vogel, Piazzi-Smyth, and others, who were unable to find the aurora line, when observing the spectrum of the Zodiacal Light, unless it was at the same time to be seen in all parts of the sky. Tacchini, Cacciatore, and Ricca similarly were unable to find it, but agreed that the spectrum was continuous, extending from about λ 5000 to λ 5550, with its maximum intensity at λ 5350; that is to say, the spectrum of the Light resembled the solar spectrum without the absorption lines.

The detection of the dark solar lines is a difficulty inherent to the observation, for the Light is so faint that, to get a visible spectrum, a broad slit is essential, and with a broad slit the comparatively fine absorption lines are lost.

Wright, in 1874, was able to use a narrower slit, and found that the spectrum, with an intensity-curve similar to that of daylight, showed traces of an absorption band in the position of the δ band in the solar spectrum.

Thus it became fairly evident that the Zodiacal Light was reflected sunlight, and the opinion now generally held is that it is reflected by a collection of small meteoritic

bodies surrounding the sun; this theory is supported by the observation that a fair percentage of the light is polarised. The recent observation of Prof. Fowler (NATURE, vol. lxxxi., p. 396, September 30, 1909), who, during an auroral display, was able to detect the aurora line everywhere, "even in the light reflected by a pocket-handerchief," illustrates the danger of attributing the auroral radiation to the spectrum of the Light, simply because it is seen contemporaneously.

To decide the question of the spectrum of the Light, photographic observations, if possible, were desirable, and, in 1883, Mr. Michie Smith attempted the task of photographing it, but was unsuccessful. Now, however, Dr. Fath has succeeded in obtaining a photograph after exercising a great deal of care and ingenuity in overcoming the numerous difficulties.

The first attempts were made, at the instigation of Prof. Campbell, in 1907 at Mount Hamilton. The spectrograph was especially designed and constructed for this research, and has an aperture of 51 mm.; the focal length of the collimator is 814 mm., and that of the camera is 154 mm. Rigidity, to withstand flexure or distortion over long periods, is the main feature of the frame, which is made of well-seasoned pine 13 mm. thick, shellaced inside and out, and put together with glue and screws. The prism is of light flint having a refractive index of 1·611 for $H\gamma$, and was set for the minimum deviation of this ray; the resulting spectrum is about 2·2 mm. in length from λ 5000 to λ 3900.

In the autumn, when the Zodiacal Light appears in the morning above the eastern horizon, less than one hour before sunrise is available for the exposures, which therefore have to be accumulative. As the altitude of the Lick Observatory is 1283 metres, it was expected that dawn might commence before the zenith distance of the sun was 108°, the usually accepted value, and in the first experiments the exposure was always stopped when the computed zenith distance was 111°; later experiments showed this precaution to be unnecessary.

In August, 1907, an exposure was made, over the period August 8 to 15, totalling 6h. 1m., and in the very faint spectrum secured absorption lines at λ 4300 and λ 3950 were suspected.

A stronger spectrum was obtained in October, 1907, with a total exposure of 11h. 9m., but still the traces of absorption were too faint to permit of any definite conclusions. Another attempt in the autumn of 1908 only served to illustrate the numerous pitfalls awaiting the observer of this evanescent spectrum. Jupiter and Venus were above the horizon, reflecting sunlight, and this so complicated matters that the experiments had to be abandoned.

On his translation to Mount Wilson, Dr. Fath resumed the inquiry, and, by the courtesy of Prof. Campbell, was able to use the same instrument. Elaborate precautions were taken to eliminate any chance of "shift" caused by the vibration or change of temperature of the spectrograph; the instrument was also mounted on an azimuth slide, so that it could be moved in azimuth some 5°, in order to follow the brightest part of the Zodiacal Light. The width of the slit employed was 0·41 mm., and at this width the solar lines H and K are not separated in the spectrum. The exposures extended from 1909 September 12 to September 25 under very favourable conditions, and were always arrested a minute or two before the time calculated for the zenith distance of the sun to be 108°. Careful watch was kept for any abnormal dawn or other phenomena which might vitiate the results, but none was observed.

With a total exposure of 12h. 31m., on a Lumière "Sigma" plate, a spectrum was obtained, under these conditions, which, so far as its small size will allow one to judge, resembles the solar spectrum exactly. Two absorption lines are certainly seen, and a comparison spectrum of daylight shows these to be G and a blend of H and K in the solar spectrum. There are no signs of bright lines on any one of the spectra obtained, and therefore, as Dr. Fath concludes, we seem justified, so far as such small, impure spectra can lend justification, in concluding that the Zodiacal Light is nothing more than reflected sunlight.

To support this conclusion it is, of course, desirable that the work should be continued, using a narrow slit to obtain greater purity of spectrum; but this entails the employment of much quicker plates than are at present available, or a much longer exposure. The latter is at present probably the most feasible plan, but when one remembers that the hours of exposure must be moonless, planetless, and clear, it is obvious that several months would be necessary to complete one such exposure. This means that special precautions to secure the constancy of the spectrograph would be necessary, and Dr. Fath suggests the construction of one with a metal frame, which would be less likely to suffer change than a wooden one, and could be maintained at a fairly constant temperature.

W. E. ROLSTON.

TECHNICAL EDUCATION IN GERMANY AND THE UNITED KINGDOM.

AT the request of Mr. R. Blair, the executive officer of the London County Council Education Committee, a valuable memorandum has been drawn up by Dr. F. Rose on the qualifications of the students trained at the German technical high schools in comparison with those of students at British universities and technical institutions of university rank. This memorandum, with the tabular portion abridged, is subjoined, and it contains facts of great interest and importance. Referring to it, Mr. Blair says:—

"The memorandum shows that one or two broad statements of fact may be made, and these deserve, if they do not demand, attention. First, the schools of the United Kingdom do an immense amount of valuable work in the evening—my own view is that the work is unparalleled. So much further education in the evening is partly due to the fact that a life of earning and independence begins earlier in the United Kingdom than in Germany, and is partly an indication of the inadequacy of the day work in these islands. It is hardly possible—and I have not attempted to do it—to assess this evening work in such a way as to place it side by side with the day work in the United Kingdom in comparing the latter with German day work, and such a comparison would also have required an appreciation of the evening work in Germany. But it has much value. Secondly, taking, as far as one can, comparable institutions, there are 12,000 fully qualified students attending day institutions for the highest technical training in Germany, and only about 3600 in the United Kingdom. The German courses are, speaking generally, longer and the previous preparation better. Further, this great difference in quality and quantity of the work done has existed for more than a generation; and these highly qualified German students have found, and do find, their way into agriculture and industry, because the German people believe in the application of trained intelligence to all forms of national activity."

Dr. Rose's report, in an abridged form, is reprinted below.

Although there is little doubt that the majority of students trained in German technical universities actually take up industrial positions upon leaving, it is impossible to give any detailed information, as no statistics on the subject have been published or are obtainable. Nine years ago I carried out an investigation to show to what an extent the German chemical industries had benefited from the chemical instruction available at universities and technical universities. The proportions still hold good for the present day, although the figures have increased. It was found that there were about 4000 academically trained chemists in the different branches of the chemical industry. The value of the annual production of the chemical industries was estimated at 50,000,000*l*.

The total number of chemists trained in Germany was estimated at the same time at about 7000. It would not be going too far to say that at least four-fifths of the German students actually take up positions in industries and technical work when they leave the technical universi-

ties; a very large number of the fully qualified students pass the final diploma examinations.

No account has been taken of the non-fully qualified students, who amount to about 10 or 15 per cent. more. A great many of these students also take up technical positions. In a large number of cases they are the sons or relatives of engineers and manufacturers who, before taking over the family works, wish to study a certain amount of technical science without submitting themselves to the drudgery of an examination.

Although it is almost a matter of impossibility to compare German technical universities with the applied science faculties and departments of English universities and with English polytechnics and technical colleges, an attempt has been made to do so in the tabular statement [here abridged so as to include totals only] given below. The difficulty of comparison arises from the fact that the German technical universities are independent technical institutions, and are organised throughout on a high level and on a uniform scale.

Technical Education in Germany and Great Britain—Educational Year, 1907–8.

Institutions	Number of fully qualified day students (German technical universities). Students taking full courses (English institutions).	Number of non-fully qualified day students (German technical universities).	Number of evening students.	General ages of day students.
GERMANY—				
Ten Technical Universities	11,692	2,299		18 or 19 to 24 and 25 and over Minimum age, 18
UNITED KINGDOM—				
Twenty-three Universities and Colleges of University rank	3,607		16,623	Entrance age, about 16
Eight London Polytechnics, and Technical Schools at Birmingham, Bolton, Leicester, Derby and Salford	461		25,574	Entrance age, about 15

Some of the points of difference may be mentioned. The matriculation for fully qualified students at German technical universities is the completion of the full nine years' secondary-school course at a classical, semi-classical, or modern secondary school. This practically amounts to a B.A. pass degree, say, at Oxford or Cambridge. There are, however, a few exceptions here and there, but they scarcely affect the almost general rule. At English institutions it is in most cases impossible to get any detailed or uniform information on this point, but it is clear that the standard of previous educational qualifications, even at many institutions of university rank, is lower than in Germany. This explains why German students do not commence work at the technical university before eighteen or nineteen, whereas at most English institutions the minimum age limit is sixteen, or there is no limit at all.

The next striking difference is the fact that there are no evening students at German technical universities, whereas in English institutions there are generally more evening students than day students.

Another point of difference is the length of the technical courses. As a rule, these last at least four years in Germany, and most students add one or two additional terms (half-years) to this period. In England the average length of the courses is less in most cases.

With regard to diplomas and degrees, the German procedure is simple and uniform at all the technical universities. The student who has successfully passed through his course of study and passed the necessary examination is awarded a diploma in his special branch. This is sufficient for the needs of the average engineer or manufacturer. If the diploma holder, however, wishes, he can spend one or two years more in research work connected with his particular branch, and can then obtain the degree of doctor of engineering by presenting his thesis and passing a further examination. This arrangement is practically uniform at all the technical universities. English scientific degrees and diplomas, however, are so diverse and numerous that it is almost useless to try and compare them with the German ones.

In addition to the simple diplomas and degrees there are other examinations which must be taken into consideration in dealing with German technical universities. These are the State examinations for State positions in State railways, mines, forests, canals, domains, smelting works; Government building, engineering, and surveying; teaching (secondary schools), post, telegraph, &c., Customs, shipyards, river and coast regulation, pharmacy, food inspection, and so forth. All candidates for these examinations must, of course, be fully qualified students.

The majority of high Government technical officials pass through the classical gymnasia before entering the technical university. The Government examination is, as a rule, more severe than the diploma examination undertaken after a four years' course at some technical universities. The diploma examination is accepted in some parts as equivalent to, or as the first section of, the official State examination for State technical positions. When the numbers of students who pass the diploma and State examinations are compared with the number of students actually at work at a technical university, it will be seen how large a number of German students complete full technical courses and pass the necessary examinations. It should also be mentioned that the majority of German technical universities exact about one year's previous practical work from fully qualified students entering their technical departments. No officials and no persons engaged in the purely commercial aspects of trade may enter as fully qualified or non-fully qualified students.

The German technical universities differ from English institutions, not only in the quality, variety, and length of their technical courses, but in the time devoted to work per day. It does not appear that the whole day is devoted to work at most English institutions. Whilst some work as much as 1000 hours per year, others work less. A minimum of 300 hours has been set up by the Board of Education for statistical purposes. At German technical universities the whole day is devoted to work, and lectures commence at seven in the summer and at eight in the winter, all the remaining time being devoted to work in drawing offices and laboratories.

The final point of difference is that the German technical universities only exist for the purpose of teaching applied science, whereas in England departments for this subject have been grafted upon universities with faculties for science, letters, medicine, law, theology, and so forth. Pure science is, of course, taught at all the older German universities in departments of the philosophical faculties.

No account has been taken in the comparison of the German mono-technical schools—that is to say, technical schools which contain only one, or perhaps two, technical departments, and which admit students about the age of fourteen or sixteen for technical courses lasting from two to four years. Such schools, which may be termed secondary technical schools, provided with fine buildings, full technical equipment, and properly staffed, number about two hundred.

A very large number of technical schools for special branches of trade exist. Such schools have been established for milling, boot-making, tanning, musical instrument making, toy-making, book-making, photography, &c. There are also numerous schools for applied art. It is very difficult to get these schools into line for purposes of comparison. They are of two types, higher and lower; there is a certain amount of overlapping, and the conditions are not uniform. They are in extremely close touch with the industries concerned, and have been founded and developed in their midst. The difference between the technical universities and the best of the technical schools mentioned above may be briefly summed up in the following table of comparison :—

Subject of comparison	At the ten technical universities	At the special engineering schools and other technical schools, with courses in mechanical engineering, building and electro-technics, &c.
Lowest entrance age	18 years	14 and 16 years
General ages	18 to 25 years	14 or 16 to 30 years
Necessary degree of previous education	The completion of the full courses (9 years) of a gymnasium or full "real" school, making, together with the three years at a preparato y school, a total of about 12 years	Qualification for the one-year military service; (6 years at a secondary school); also completion of the "Volkschule" (elementary school) and a knowledge of mathematics and some years' practical work
Scope and manner of instruction	Advanced and complete application of higher mathematics and mathematical sciences. advanced theory and design, facilities for the attendance of lectures in the departments of chemistry, civil engineering, architecture, art, science and literature	A certain measure of instruction complete within certain limits, specially arranged for practical requirements, no higher mathematics. elementary theory and design; no facilities for instruction in other technical departments or in letters, languages, philosophy, &c.
Aim of the instruction	Training of experts, great inventors, high technical State and municipal officials, "captains of industry," owners and managers of great works, professors, secondary teachers, consulting men of science, engineers, architects, chemists, patent agents, &c.	Training of owners and managers of smaller works, foremen, clerks of works, surveyors, minor State and municipal officials, draughtsmen, technical travellers, &c.
Previous period of experience in works	Generally 1 year as minimum, with a tendency to increase	2 to 4 years as minimum, 2 years being exacted almost without exception; very strictly observed
Length of courses ...	4 years in almost all cases, with a tendency to increase	2 to 2½ years, sometimes 1½ years, in rare cases 3 and 3½ years
State and municipal technical appointments open to students who have completed the courses	Higher appointments in the State and municipal technical services	Lower appointments in the State and municipal technical services
Attendance at lectures	No compulsion...	Obligatory

Although English universities have been included in the comparison, no mention has been made of the following German institutions of equal or similar rank :—

The twenty older universities (excluding the theological universities of Braunsberg and Münster)	They contain 48,000 students. Of these a large number study chemistry, which is a department of the faculty of philosophy at all German universities
The three agricultural high schools	Same educational qualifications as at the technical and older universities. Exceptions, however, are allowed. Number of students=1402
Agricultural departments	At seven of the older universities and at one technical university
The five veterinary high schools	Same educational qualifications as at the technical and older universities. Number of students =1321
The four forestry academies	Same educational qualifications as at the technical and older universities. Number of students =262
The forestry departments	At three older universities and one technical university
The three mining high schools	Same educational qualifications as at the technical and older universities. Number of students =791
Various	A mining department at Aix Technical University. A veterinary department at Giessen University

The result of this comparison between German and British technical institutions shows that the former are constituted and organised on a higher level. With the possible exception of the Imperial College of Technology and applied science departments at Cambridge, Edinburgh, Glasgow and Victoria Universities, Trinity College, Dublin, and some university colleges, there do not appear to exist in the United Kingdom technical institutions which can be compared with any of the great German technical universities.

Looked at from the basis of the German standard of previous education and practical work, length, extent, and variety of the courses taken, and the number of diplomas granted, it will probably be found that there are insufficient students in the whole country to fill one of the large German technical universities. Here and there a number of students in a few departments come up to the German level. Good technical institutes and departments in England appear to be more on a level with the best technical schools in Germany rather than with the technical universities. Such schools are, for example, the Prussian higher mechanical engineering schools at Dortmund, Elberfeld, Breslau, and Cologne, the trade academy at Chemnitz, the technical school at Cöthen, and several "Technikums." These schools do not admit students before sixteen, require a six years' certificate from a secondary school and proof of two years' practical work, and have a course of at least two years. They are very numerous in Germany.

In England the tendency during the last ten years has been to graft departments for higher applied science upon the older or modern universities. This was done in Germany very many years ago and soon abandoned. For example, engineering was once taught at Giessen University, higher mechanics at Munich University, and technology at Göttingen and other universities. At the beginning of the nineteenth century lectures on technology were given at Heidelberg, which were suitable in every respect for a technical school. Building, mining, metallurgy, forestry, surveying, and other subjects were also taught. At the present time, with few exceptions, applied science and technology generally have gone to the technical universities and institutions of similar rank and to the technical schools. Only comparatively few departments survive, such as forestry, veterinary and agricultural science, which are still taught partly at the older universities, but principally at independent institutions. A very large amount of chemistry, principally pure chemistry, is taught at all German universities. It forms the great exception to the rule, and was taught so far back as the beginning of the seventeenth century. Different countries have, of course, followed different lines of procedure in the development of their higher technical instruction.

The German technical universities are not, strictly speaking, new creations. They have been developed—with one exception—from technical schools, trade schools, &c., founded in the first quarter of the nineteenth century. One of the great reasons for the foundation of these schools was to render Germany independent of the English manufactures and machinery, which, together with English capital and engineers, overran Germany in the first half of the nineteenth century.

The present organisation of English polytechnics represents a stage of development which German technical education passed through about forty years ago, and out of which nine of the ten technical universities have arisen.

There is little doubt that the rapid development of the German technical universities is owing, to a great extent, to their independent position towards the older universities. They do not enter into competition with them, but supplement them by providing a new type of instruction which the older universities, by reason of their environment, traditions, and organisation into the four faculties of law, medicine, theology, and philosophy, cannot give. The same is true of the semi-classical (Realgymnasia) and modern secondary schools (Oberrealschulen). Instead of attempting to graft a large amount of science, modern languages, mathematics, and drawing upon the older classical gymnasia, new secondary schools were created with the same length of courses, but of a semi-classical or completely modern type. All three types remained independent, and have consequently flourished, although the State still favours the classical gymnasia in State appointments and the liberal professions. As the technical universities developed so did the new types of secondary schools from which they receive so many of their students. Coordination between the older and the technical universities has been effected in a simple manner by making the leaving certificate of the secondary schools (the "Maturitas") the standard of matriculation for both types of university, and by putting university and technical university terms on the same footing as regards the length of study for the final examination.

The Emperor William has greatly influenced the rise of the technical universities by his consistent efforts to raise the status of the three (now four) situated in Prussia. He began by suggesting reforms in the secondary-school system, then called the principals of the technical universities into the Prussian Upper House, and finally conferred upon the Prussian technical universities the power of granting the degree of Doctor of Engineering. The rest of the Empire followed his example, and thus the ten technical universities have been finally placed upon exactly the same footing as the older universities.

One reason why technical-school students in Germany possess a better educational equipment for their work than in England is owing to the fact that the lower divisions of the secondary schools are filled by students who wish to obtain the one-year military certificate which requires six years' attendance at a secondary school. The high proportion of fully qualified students at the technical universities is due to the fact that no examinations can be passed or higher State or municipal positions obtained without proof of the completion of a nine years' secondary-school course. Another reason why so many students attend the secondary schools and various universities in Germany is due to the lowness of the fees and the cheapness of living. To these reasons may be added the general German tendency to obtain as high a standard of schooling as possible before entering life.

Young men in Germany subject themselves to a laborious general and technical training, amounting after the preparatory school to from ten to fifteen or sixteen years, because the majority of those who complete their studies are generally sure of finding positions. The State and municipalities require large numbers for their various technical services. This partly explains the interest of the State in the quality of the instruction and the uniformity of the organisation of the technical universities. Most manufacturers give the preference to students with diplomas or degrees from the universities or technical schools. This is a result of the intimate advisory relations between manufacturers and the technical universities. Students are also sure of finding positions in the surrounding foreign countries, where large numbers of German "techniker" are to be found in all branches of industry. A further incentive to a longer course of study is found in the fact that, owing to the system of marriage dowries in Germany, young men with a technical diploma or degree are able to marry as soon as they obtain a position, even with a very small initial salary.

German students receive very little direct pecuniary assistance. Scholarships on the liberal English scale are practically unknown. There are a few modest "stipendia," and very poor students, upon production of the necessary proof, are allowed to study free and refund the amount of their fees later when they are in a position to do so.

Higher education of all types in Germany has been promoted by two further factors. First, by decentralisation so far as the Empire is concerned, as the various States of which the German Confederation is composed act independently in educational matters, and are constantly competing with one another in the development of their educational resources. Secondly, by the fact that almost all higher education is under direct State control, thereby rendering uniformity of organisation and coordination between institutions more easy.

Finally, it should be borne in mind that the German population exceeds the population of the United Kingdom by about eighteen or nineteen millions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Rev. E. A. Woodruffe-Peacock will deliver a lecture at the Botany School on Friday, February 18, at 5.0 p.m., on "A Special Method of Recording the Distribution of Plants." The lecture will be open to all interested in the subject.

Prof. W. Bateson, the Hon. N. C. Rothschild, and Mr. H. Scott, Inceptor in Arts, have been nominated to represent the University at the International Congress of Entomology to be held at Brussels in August, 1910.

Sir J. Larmor has been nominated a member of the board of electors to the professorship of chemistry, Sir Robert Ball to that of the Plumian professorship of astronomy, and Dr. Glaisher a member of the same board; Prof. A. Robinson and Prof. A. Keith have been nominated members of the board of electors to the professorship of anatomy, Dr. Darwin to that of the professorship of botany, Prof. W. W. Watts to that of the Woodwardian professorship of geology, Mr. A. Hutchinson to the same board, Prof. H. B. Dixon to that of the Jacksonian professorship of natural and experimental philosophy, Prof. A. R. Cushny to that of the Downing professorship of medicine, Dr. Hugo Müller to that of the professorship of mineralogy, Dr. R. T. Glazebrook to that of the Cavendish professorship of experimental physics, Dr. W. N. Shaw to that of the professorship of mechanism and applied mechanics, Prof. F. Gotch to that of the professorship of physiology, Sir W. W. Cheyne, Bart., and Mr. C. T. Dent to that of the professorship of surgery, Prof. J. Lorrain Smith to that of the professorship of pathology, and Mr. E. Gardner, M.P., to that of the professorship of agriculture.

LONDON.—In memory of the late Dr. Ludwig Mond's scientific eminence and his generous benefaction of 3000*l.* towards the building of the Institute of Physiology at University College, the college committee has resolved to name the biochemistry research department of the institute "The Ludwig Mond Biochemistry Research Laboratory." The committee will shortly proceed to elect a Crewdson-Benington research student. The studentship, of the value of 50*l.*, tenable for one year in the biometric research laboratory of the college, is for the promotion of research in anthropometry and craniology in relation to evolution. Candidates should send their applications, together with any statement of qualifications that they desire to submit, not later than March 1 to the secretary of University College, Gower Street, W.C., who will furnish particulars of the studentship.

The degree of D.Sc. has been granted to Mr. W. B. Tuck, an internal student, of University College, for a thesis entitled "The Constitution of Hydroxyazo-compounds," and other contributions.

A scheme for the constitution of a board of the faculty of medicine has been approved.

Syllabuses have been approved in geology for intermediate and final pass B.A. examinations for external students. Practical work is provided for in both syllabuses; that for the intermediate examination includes the interpretation of weather charts, and at the final examination candidates must give evidence of adequate instruction in the field.

Prof. A. W. Crossley, F.R.S., has been elected dean of the faculty of science in succession to Prof. J. M. Thomson, F.R.S., resigned.

Dr. E. C. Seaton and Mr. W. H. Maxwell have been appointed Chadwick lecturers in hygiene and municipal engineering for the current session.

Convocation has approved the proposals for the establishment of a University of London Club.

AT the South-western Polytechnic Institute, Chelsea, on March 11, Sir William H. White, K.C.B., F.R.S., will present prizes and certificates to students of the evening classes and day college.

THE twelfth annual dinner of the Central Technical College Old Students' Association was held on Saturday, February 12, at the Trocadero Restaurant, Mr. H. A. Humphrey being in the chair. Among the guests of the evening were Sir Philip Magnus, M.P., who, in proposing the toast of the association, mentioned the great progress the Central Technical College has made and the invaluable training received there. Prof. W. J. Pope, F.R.S., was elected president for 1910.

AN interesting address to the junior members of the architect's profession was given on January 31 by Mr. Ernest George, president of the Royal Institute of British Architects, and has been printed in the *Builder* for February 5. Mr. George offered much valuable advice to the student; earnest application is necessary, and a thorough education in science and art, as well as in wider fields of knowledge. There will be no time for idling; an

architect must recognise that he is a man of business, with grave responsibilities to his client, and must cultivate methodical habits and exactness. The art of public speaking should be part of the architect's equipment; he may thus often contribute profitably to discussions.

THE scheme for a London pageant which was before the public some time ago is now merged into a larger scheme of a Festival of Empire, to be held at the Crystal Palace this summer in the months of May, June, and July. The London pageant will form part of the scheme of the festival of empire. The council of the festival has invited the cooperation of the University Extension Board of the University of London in arranging courses of lectures preparatory to the pageant. The Board has accordingly arranged a course, to be given by Mr. Kenneth H. Vickers, on the history of London, arranged specially in view of the pageant of London to be held at the Crystal Palace as a part of the festival of empire. This course will be given in the London Day Training College on Thursday evenings at 8 o'clock, beginning February 17, when Sir R. Melvill Beachcroft, chairman of the London County Council, will take the chair. It is hoped that further courses of this kind will be arranged in different parts of London later in the year.

OF recent years the system of furthering scientific research most in vogue has consisted in the foundation of studentships or fellowships tenable at some university, for which recently graduated students of that or other universities are eligible. While this movement has undoubtedly led to the performance of a large amount of research in experimental science, and has, in this respect, been an unqualified success, it is a matter of common experience that the holders of these endowments have not, as a rule, reached a sufficiently mature age or acquired sufficient experience to initiate and develop original work in pure science. Indeed, it is not uncommon to find a successful research student baffled by a comparatively simple problem in mathematical analysis. In an article on "An Empire University" in the *Standard* for February 7, Dr. Waller, F.R.S., proposes a scheme which would obviate this difficulty. He suggests a class of appointment the holder of which should devote half his time to, and receive half his stipend from, teaching, the other half of his time being given to research, for which the corresponding remuneration should take the form of a fellowship. It is pointed out that this combination of teaching and research could not fail to have a beneficial effect in infusing an element of originality and individuality into the teaching. Dr. Waller's proposal might further have the advantage of improving the position of the existing underpaid assistant lecturers in our university colleges. Many of these at the present time turn out really excellent original work in addition to teaching, in return for a stipend which compares unfavourably with the awards made to research students for advanced study alone. There certainly appears to be a loss of efficiency in the existing system.

THE annual meeting of the Association of Technical Institutions was held at the Skinners' Hall, London, on February 11 and 12. Dr. R. T. Glazebrook, F.R.S., president of the association, delivered his address, and dealt with the questions, What should be the aims of those teachers whose work lies mainly in the technical institutions of the country, and what should be their position in the scheme of education which is being gradually evolved? He pointed out that in Germany the great technical institutions have developed almost independently of the old universities, and asked, Are we to look forward to the growth of technical universities in each town arising naturally out of the technical colleges, but independent of and at the same time rivals of the existing universities? The answer Dr. Glazebrook thinks should be in the negative, with possibly one or two exceptions. It would be suicidal to suggest that in Manchester, Birmingham, Leeds, or Liverpool there should be two degree-giving bodies, one concerned with arts and pure science and the other with applied science. Modern universities, he said, will do for us what technical high schools have done for Germany. Speaking of London, Dr. Glazebrook said we may take it that the Imperial College of Science and Technology will in time become the technical university of London, whether as a part of London University or as a new university. On the second day of the meeting a general discussion took place upon the examination of evening students by the Board of Education, the City and Guilds Institute, the Royal Society of Arts, and the London Chamber of Commerce. Speaking on behalf of the Board of Education, Mr. C. A. Buckmaster said the Board is at present considering the whole subject of examinations, and will be glad to receive any information which the association can put before it. It realises the immense difficulties connected with the long period of the examinations, and will be prepared to do what it can to diminish the inconvenience. With regard to the Whitworth examinations, the Board of Education has to administer the will of Sir Joseph Whitworth, and though slight modifications of the scheme are possible, it would require an Act of Parliament to enable the Board to put it wholly into the melting-pot so that it may come out in a different form. After further discussion, a resolution was passed instructing the council to consider the subject of examinations in all its bearings.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. C. **Chree**: Some phenomena of magnetic disturbances at Kew. A recent paper ("Phil. Trans.," A, vol. ccviii., p. 205) discussed the diurnal inequality of Kew magnetic declination derived from 209 of the most highly disturbed days of the eleven years 1890 to 1900. The present paper discusses the corresponding phenomena for the same days in the other magnetic elements. It is shown that the irregular changes which form the most obvious feature of magnetic storms are accompanied by large *regular* diurnal changes, which are specially striking in the vertical force. In this element the disturbed days referred to above gave a regular diurnal inequality, the range of which in the average month of the year was about four times that given by the Astronomer Royal's "quiet" days. The influence of the hour of the day on the character of the disturbance is visible even on casual inspection of the vertical force curves. When disturbances lasting only a few hours occur in the late afternoon, there is almost invariably a rise in the force, whereas when they occur in the early morning there is a fall. Besides dealing with the analysis of the diurnal inequalities derived from the disturbed day curves, the paper discusses some new phenomena observed in the a-periodic changes of the magnetic elements.—R. B. **Sangster**: A novel phenomenon in the diurnal inequality of terrestrial magnetism at certain stations. The mean diurnal inequality at Greenwich for epoch 1900–6, at Falmouth, 1903–7, and at Pawlowsk (Russia), 1873–85, is dealt with so as to exhibit the inequality in the plane of the astronomical meridian. It is then shown that the component of the force parallel to the earth's axis has little, or no, variation during the hours from noon to about 5 p.m. There is, however, considerable simultaneous variation in the declination and in the horizontal and vertical forces. The winter months invariably showed a shorter duration of the feature, and, generally, a larger diurnal range produced a more exact and lengthened exhibition of the phenomenon. The phenomenon was found to exist whether "quiet" days or "all" days were dealt with, and, while long periods naturally furnished smoother curves, the feature was also prominent in cases where the mean of only five "quiet" days in a single month was employed.—Prof. P. V. **Bevan**: The absorption spectra of vapours of the alkali metals. The paper gives an account of the absorption spectra of vapours of the metals potassium, rubidium, and cæsium. Prof. R. W. Wood has shown that the absorption spectrum of sodium vapour has for its most striking feature the lines of the principal series. The same series lines for the metals of this communication appear in the absorption spectra. The author has measured the wave-lengths of these lines so that now 24 potassium lines, 25 rubidium lines, and 19 cæsium lines are known of the principal series. Of these, 15 are new in the case of potassium, 21 in the case of rubidium, and 12 in the case of cæsium. In the cases of rubidium and cæsium, the metals themselves were not available, but by heating the chlorides with sodium or

potassium, enough vapour was obtained to show the absorption spectrum quite definitely. These lines, with the lines measured by Wood for sodium, give good data for testing various formulæ that have been suggested for representing the series lines. None of the suggested formulæ tested give values representing the series within the limits of experimental error. In particular, the quantity of Rydberg's formula N_0, or of the modified Rydberg formula of Rit_2, is shown not to be constant. One of the most interesting facts arising out of the investigation is that none of the lines of the associated series appear in these absorption spectra. Channeled space spectra appear which are analogous to the similar spectra for sodium vapour. Further interesting facts noted are in regard to the effect of mixtures of vapours. Some lines or bands appear in spectra of mixtures which are apparently unconnected with the spectra of either constituent. This was specially evident in the case of cæsium and sodium; a set of bands appeared at about W.L. 3000–3500 which do not appear in the sodium spectrum, nor in the mixture of potassium and cæsium spectrum. Other interesting phenomena appear as the density of the vapour is increased in the widening of the lines and the appearance of satellites connected with the lines of the series. The vapour of lithium has not yet been successfully investigated, as it attacks the material of all tubes hitherto tried.—Prof. C. H. **Lees**: The shapes of the isogeotherms under mountain ranges in radio-active districts. The author shows that for mountain ranges of many different forms of section, the shapes of the isogeotherms may be accurately determined in cases in which the heat conductivity and radio-activity of the materials of the range may be taken as constants. Curves showing the isogeotherms in three typical cases are given, and it is shown that some of the statements generally made with respect to them are not correct.—F. B. **Pidduck**: The propagation of a disturbance in a fluid under gravity. The paper relates to the determination of the motion set up in a heavy incompressible fluid of uniform depth by a limited initial disturbance; the generally accepted solution in terms of a definite integral represents the disturbance as being propagated instantaneously, although the velocities of the simple harmonic wave-trains of which the solution is built up are all finite. In the paper this solution is transformed into a series-solution analogous to that given by Cauchy and Poisson for infinite depth. In the more general problem of one-dimensional motions in dispersive media the integral solution may represent the disturbance as either being limited at any time by an advancing wave-front, or as being propagated instantaneously. A method, based on the examination of the convergence of the definite integral, is given for deciding between these conditions. An investigation is given of the propagation of waves over a slightly compressible heavy fluid. Solutions of the Cauchy-Poisson type give motions which such a fluid can execute; but these are not due to limited initial disturbances, as they imply a diffused initial condensation. The corresponding result for incompressible fluids is that solutions of the type in question imply a diffused unequilibrated distribution of pressure on release from the initial state.—Dr. A. H. **Gibson**: The flow of water through pipes and passages having converging or diverging boundaries. A series of twenty-five pipes, all having the same initial and final area, but having different angles of convergence or divergence, were examined. Some of these pipes were circular in section; others square; others rectangular. The following are the main conclusions:—(*a*) In a circular pipe with uniformly diverging boundaries, the total loss of head attains its minimum value with an angle of divergence θ of about 5° 30′. Owing to the comparatively large effect of friction in a pipe having a small value of θ, the value giving the minimum loss of head will be somewhat less in pipes larger than those examined, which had a larger diameter of 3 inches and a smaller diameter of 1·5 inches. (In large pipes of the type used in the Venturi meter, experiment shows that this value is about 5° 6′.) As θ is increased the loss of head, expressed as a percentage of $(v_1-v_2)^2/2g$, increases very rapidly from its minimum value of about 13·5 per cent. to a maximum of about 121 per cent. when $\theta=63°$, afterwards diminishing to about 102 per cent. as θ is increased up to 180° (a sudden enlargement of section). (*b*) The effect of making the pipe trumpet-shaped so as to give a rate of change of velocity uniform per unit length of the pipe may in some cases be to increase, in other cases to reduce, the loss of head. In the only case tried in the circular pipes the loss in the trumpet-shaped pipe was 23·5 per cent., as against 17·3 per cent. in a straight taper pipe of the same length, and having θ equal to 10°. In the case of a rectangular pipe, however, boundaries curved to give respectively uniform retardation in time and length ($dv/dt=$ const.) and ($dv/dx=$const.), showed that the loss, as compared with that in the corresponding straight-taper pipe ($\theta=20°$), was reduced respectively by 5·3 per cent. and 12·1 per cent. Further experiments are desirable to determine precisely the form of curve giving least loss of head. (*c*) The loss of head in a pipe of square section is greater—at the least 20 per cent. greater—than in a circular diverging pipe of the same length and same initial and final area, while the minimum loss is obtained when the angle between opposite faces of the pipe is approximately 4°. (*d*) A change in the shape, as opposed to the area, of the cross-section of a pipe leads to considerable loss of head. Thus, by changing the section of a pipe from that of a square of 2·66 inches side to a rectangle 1·33 inches by 5·32 inches in a length of 9·94 inches, a loss of head equal to 0·484 $v^2/2g$ was experienced. (*e*) Where a rectangular pipe has one pair of sides parallel and the second pair uniformly diverging, the loss of head is much greater than in a circular pipe having the same length and the same initial and final areas. The minimum loss is obtained with θ about 11°. (*f*) The critical velocity of flow in a circular pipe with uniformly converging boundaries is much greater than in a parallel pipe of the same mean diameter. The critical velocity increases rapidly with the angle of convergence, its lower value, at 57·5° F. in the experimental pipes (from 3 inches to 1·5 inches diameter), being as follows at the point where the diameter is 2¼ inches:—

θ	5°	7½°	10°	15°
C.V. (ft. per second)	2·7	3·4	4·3	5·7

The lower critical velocity in a parallel pipe of the same mean diameter is 0·13 foot per second at this temperature.—R. **Rossi**: The effect of pressure upon arc spectra:—Titanium. The work is on the range from λ4000 to λ4600, examined with the 21½ ft. concave grating spectrograph of the Manchester University Physical Laboratory, which gives on the photographic plate a dispersion of 1·3 Ångström units per millimetre. The arc was formed between a carbon pole and a graphite tube filled with titanium carbide. The pressures at which the photographs were taken were 15, 30, 50, and 100 atmospheres. The broadening, reversal, displacement, and changes of relative intensity of fifty-two lines were studied. All lines were found to broaden out with an increase of pressure, the amount and type of broadening being different for different lines. Several lines were found to reverse under pressure, some symmetrically and some asymmetrically. All lines were found to be displaced towards the red end of the spectrum, the displacement being a linear function of the pressure within the limits of accuracy of experiment. The value of the displacement varies for different lines, and the unreversed lines cannot be grouped into sets giving the same displacement. The reversed lines, however, with the exception of one, can be formed into two groups, their mean displacements being very nearly in the ratio 3 : 5. The mean displacement per atmosphere of all the titanium lines studied is found to be 0·003652 Ångström unit. The limited number of lines studied, both in this work and by other workers on the Zeeman effect, do not enable one to obtain any relation between the pressure displacement and magnetic separation. The relative intensity in nearly all lines is altered by pressure, and a list is given of the lines which are thus enhanced or weakened.—Sir James **Dewar** and Dr. H. O. **Jones**: The change of carbon disulphide into a gaseous product condensable and explosive near the temperature of liquid air.

Physical Society, January 21.—Dr. C. Chree, F.R.S., president, in the chair.—R. E. **Baynes**: Saturation specific heats, &c., with van der Waals's and Clausius's characteristics. By use of a special variable, exact expressions may be found with van der Waals's characteristic for the specific heats **s**, **s′** of saturated liquid and vapour and for all other magnitudes connected with the state of

saturation, and if **k** denotes the isometric specific heat, which is constant or a function of the temperature only, (i) **s**−**k** is always positive, increasing from R to ∞ as the reduced temperature τ rises from 0 to 1; (ii) **k**−**s**′ is always positive, having a minimum value 4·96 R when $\tau=0.72$, and being ∞ when τ is either 0 or 1; (iii) inversion in the sign of **s**′ can thus occur when $\mathbf{k}/R>4.96$ or $\kappa=1+R/\mathbf{k}<1.202$, so that, on the assumption that $\mathbf{k}/R=N+\frac{1}{2}$ for an N-atomic gas, inversion can occur only if the gas has at least *five* atoms in its molecule; (iv) the latent heat of vaporisation increases continuously from 0 to its largest value (27/8)RT as τ falls from 1 to 0, T being the absolute critical temperature; (v) the work of vaporisation has a maximum value 0·55 RT when $\tau=0.70$. Clausius's characteristic similarly treated gives widely different results:—(i) while **s**−**k** is always positive, it is ∞ when τ is either 0 or 1, having a minimum value 15·3 R for $\tau=0.83$; (ii) **k**−**s**′ is always positive, is ∞ when τ is either 0 or 1, and has a minimum value 11·36 R for $\tau=0.81$; (iii) inversion in the sign of **s**′ can thus only occur if $\mathbf{k}/R>11.36$ or $\kappa<1.088$, or, on the above assumption, if there are at least *eleven* atoms in the molecule; (iv) the latent heat of vaporisation increases continuously from 0 to ∞ as τ falls from 1 to 0; (v) the work of vaporisation has a maximum value 0·69 RT when $\tau=0.77$. The contrast between these results is especially marked for **s**−**k** and the latent heat.—Prof. **Thornton**: The polarisation of dielectrics in a steady field of force. Experiments on the polarisation of dielectric ellipsoids and cylinders suspended in a steady electric field. From measurements of the field-intensity, the dimensions of the ellipsoids, and the frequency of torsional swings with and without the field, the dielectric constant can be found from time to time. The longitudinal component of polarisation reached a higher value than previously recorded, and was found to be independent of the intensity of the field inside the ellipsoid and to be quasi-elastic in type. Quartz, fused and crystalline, flint-glass, amber, sulphur, ebonite, rubber, gutta-percha, paraffin-wax, resin, and sealing-wax were examined. From the rate of increase of the dielectric constant the specific resistance of these was found by considering the change of polarisation to be equivalent to a current. The rate of depolarisation when the field was reversed was the same as that of polarisation, and uniform for several hours. The cause of this and for the independence of the field-intensity may be looked for in the continued separation of molecular charge by the attraction of the opposite charges on adjacent molecules induced by the application of the field. From a comparison of these results and those in alternating fields, the variation of the dielectric constants with frequency can be anticipated.—A. **Campbell**: The use of mutual inductometers. In the use of mutual inductometers, the use of a balancing coil in one arm of the bridge causes considerable loss of sensitivity. With an equal-arm bridge this difficulty is overcome by putting the halves of the secondary circuit in adjacent arms of the bridge. The auxiliary balancing coil is dispensed with, and the usual formula is applicable. The measurement of effective resistance, which is, in general, more troublesome than that of self-inductance, was discussed. The effective resistance determines the total power spent by an alternating current in a conductor, and is important in telephonic and other high-frequency work. When measured by a self-inductance bridge, large errors may be introduced by the small residual inductances of the ratio arms. The analogous formulas for mutual inductance bridges, which indicate that the inductances of the ratio arms must be accurately proportional to their resistances if errors are to be avoided, are here worked out. A null method in iron testing analogous to Max Wien's self-inductance method is described. The ring to be tested is wound with primary and secondary coils. The magnetising current, I_1, is passed through the primary coil, the primary circuit of a mutual inductometer, and a slide-wire resistance. The detecting instrument is put across a circuit consisting of the secondaries of the ring and the inductometer in opposition, and a part, Q, of the slide-wire resistance. By adjusting Q and the reading M of the inductometer a balance is obtained, in which case the power lost in the ring is equal to $QI_1^2\times N_1/N_2$, where N_1 and N_2 are the numbers of turns in the windings of the ring. The method is applicable to the testing of current transformers.

Mineralogical Society, January 25.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Dr. S. J. **Shand**: A group of minerals formed by the combustion of pyritous shales in Midlothian. At the Emily coal-pit, Arniston, as the result of the slow combustion of a heap of shaly refuse, which became spontaneously ignited, presumably owing to the evolution of heat caused by the atmospheric oxidation of pyrites, a number of uncommon mineral species have been formed, of which five have been recognised, viz. native sulphur, sal-ammoniac, tschermigite, mascagnite, and a possibly new species, aluminium sulphate.—Prof. W. J. **Lewis**: A crystal-holder for measuring large specimens. For this purpose a clamp of convenient form and with various adjustments has been designed and made by Mr. Pye.—T. **Crook**: Some observations on pleochroism. The phenomena of pleochroism displayed by plates of coloured minerals when examined in ordinary light were treated in a general way for both parallel and convergent rays, and the factors upon which they depend were discussed.—L. J. **Spencer**: Notes on the weight of the "Cullinan" diamond, and on the value of the carat-weight. Varying statements of the weight of the "Cullinan" diamond, in its original, uncut form have been published, but from a comparison of the carat-weights against which it was weighed in 1905 it is concluded that the correct weight was 621·2 grams, or 3025¾ English carats of 205·304 milligrams (as defined by the Standards Department of the Board of Trade in 1889). Other values are, however, given for the English carat and for the carat in other countries, and the average value has decreased, on the whole, in course of time. The carat-weight had its origin in the use as weights of seeds of *Ceratonia siliqua*, which weigh approximately a carat. The existing confusion would be obviated by the general adoption of the metric carat of 200 milligrams (one-fifth of a gram) recently recommended by the International Committee of Weights and Measures (NATURE, 1908, vol. lxxii., p. 611).—Dr. G. T. **Prior**: A basalt from Rathjordan, Co. Limerick. Specimens of basalt from Rathjordan in the Allport collection in the British Museum show in thin slices under the microscope round sections of isotropic material containing central and marginal inclusions, and thus resembling small leucites. The rock is very similar, mineralogically and chemically, to leucite-basalts from Bohemia, but contains only a small fractional percentage of potash. This fact, combined with observations of the refractive indices, leads to the conclusion that the isotropic material is mainly analcite, and not leucite.—Dr. G. F. H. **Smith** and Dr. G. T. **Prior**: A fluo-arsenate from the Indian manganese deposits. A crystallographical and chemical examination made of the green arsenate from Kajlidongri, Jhábua State, mentioned in Mr. Fermor's monograph on the manganese-ore deposits of India (Rec. Geol. Surv. India, 1908), led to the following results:—composition, $(MgF)CaAsO_4$; specific gravity, 3·768; hardness, 3½; colour, apple- to brownish-green; monoclinic, $a:b:c=0.7485:1:0.8453$, $\beta=120°\ 50'$; forms present, (010), (110), (111), ($\bar{1}$31), (311), ($\bar{1}$12), ($\bar{1}\bar{5}2$); good cleavage parallel to ($\bar{1}$01), and partings parallel to (110), ($\bar{1}$02), (331); twin plane, (100); refractive indices, 1·640, 1·660, 1·666; acute bisectrix nearly perpendicular to ($\bar{1}$01), and axial plane at right angles to the plane of symmetry, but no horizontal dispersion was noticed; $2E=105°$ approximately, with negative birefringence. The material is probably identical with tilasite, which was first described by Sjögren in 1905 from the manganese deposits of Långban, Sweden.—H. E. **Clarke** and Prof. H. L. **Bowman**: The composition of a stone from the meteoric shower which fell at Dokáchi, Bengal, on October 22, 1903. The small crusted stone examined, weighing 17·8 grams, shows chondritic structure, and belongs to the class Ci of Tschermak. The chief constituent minerals are bronzite (37·9 per cent.), olivine (37·7 per cent.), nickel-iron (18·5 per cent.), troilite (4·1 per cent.).—Dr. G. F. H. **Smith** exhibited cut and rough specimens of synthetical sapphire recently produced by Prof. Verneuil, oxides of iron and titanium being the colouring agents.

Geological Society, January 26.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: A skull of Megalosaurus from the Great Oolite of Minchinhampton. The specimen was discovered and prepared by Mr. F. Lewis Bradley, and shows, for the first time, the skull of Megalosaurus. It agrees closely with the megalosaurian skulls of other genera already discovered in the Jurassic and Cretaceous of North America, and resembles Ceratosaurus in possessing a bony horn-core on the nose. As in the jaws of Megalosaurus previously known, the premaxilla of the new specimen bears four teeth; but these teeth are so different from those of the typical *M. bucklandi* of the same horizon that they prove the Minchinhampton fossil to belong to a distinct species.—A. M. **Finlayson**: Problems of ore-deposition in the lead and zinc veins of Great Britain. Chemical analyses show traces of lead and zinc in several of the rock-formations of Britain, but the ores of the veins are concluded to be derived, not from the country-rock, but from deeper sources, probably in the first place by magmatic segregation. They were transported in the deeper zones by "juvenile" waters, in which fluorine was an important constituent, while in the upper zones, especially in limestone districts, underground waters of meteoric origin have played a large part. The vein-solutions carried (1) alkaline sulphides, which held the sulphides of the metals in solution, and (2) alkaline and earthy carbonates. The presence of the latter is indicated by the alteration of the wall-rock, which shows a concentration of potash, lime, and carbon dioxide, and a leaching of soda, magnesia, oxides of iron, and silica. In limestones, however, the chief effects of solution on wall-rock were concentration of silica and magnesia. Ore-deposition has persisted over a vertical range of 5000 to 6000 feet, of which more than one-half has been shorn off by denudation. The effects of secondary processes have been exerted to depths of more than 600 feet.—J. W. **Jackson**: The vertebrate fauna found in the cave-earth at Dog Holes, Warton Crag (Lancashire). The remains described in this communication were obtained during the systematic investigation by the author of a cave on Warton Crag (west Lancashire) in 1909. The cave, known as Dog Holes, is situated on the western side of Warton Crag, and opens on a sloping "pavement" of limestone. It owes its origin to the erosion of a series of master-joints in the Carboniferous Limestone. The specimens were derived from the cave-earth below the surface-soil in one of the chambers of the cave. They comprise a large series of small vertebrates, including rodents, Insectivores, amphibians, birds, &c. Among the rodents are some interesting forms, the chief of which are the Arctic and Norwegian lemmings and the northern vole. A large series of non-marine Mollusca was found along with these remains, one species being of particular interest, namely, *Pyramidula ruderata*, only known in this country by its fossil remains in Pleistocene deposits. The Pleistocene age of the remains is fully discussed, as well as their possible mode of origin through a former swallow-hole. In many respects the cave and its contents bear a striking resemblance to the famous Ightham fissures.

Zoological Society, February 1.—Prof. E. A. Minchin, vice-president, in the chair.—The Hon. P. A. **Methuen**: A collection of fresh-water Crustacea from the Transvaal. An account of some Entomostraca collected from Lake Chrissie and other pans or lakes in the Carolina district, which is high veldt country lying near the borders of Swaziland. The paper also gave a short description of the "lie" of the lake, and notes on the geology of the district and the composition of the water.—Dr. J. **Pearson**: Holothurioidea from the Kerimba Archipelago, Portuguese East Africa, and from the Mergui Archipelago, Lower Burma. The collection from the Kerimba Archipelago contained twenty-one species, all of which had been previously described. In this paper it is proposed to establish a new genus for the inclusion of *Colochirus violaceus*, Théel. The collection from the Mergui Archipelago called for no special comment, none of the fourteen species being new.—Dr. G. S. **Brady**: A revision of the British species of Ostracoda belonging to the subfamilies Candoninæ and Herpetocyphridinæ. The paper was a synopsis intended to show our present knowledge of the families referred to, describing briefly the known British species. Some few new genera and species, and others already described by foreign authors but not previously recognised as British, were dealt with.—F. E. **Beddard**: The anatomy of *Hippopotamus amphibius*.

Royal Anthropological Institute, February 8.—Mr. J. Gray, treasurer, in the chair.—A. L. **Lewis**: Some dolmens of peculiar types in France and elsewhere. The author described several *allées couvertes* in the department of the Oise, in France, which have at one end an open portico or shrine with a round hole 18 inches in diameter opening into the *allée*. He then sought to find the monuments most nearly resembling them, which appeared to be some of those in the provinces of Bohuslan and Vestergothland, in Sweden, described by Dr. Oscar Montelius. The "Giants' Graves" in Sardinia, recorded ninety years ago by Count de la Marmora, and quite recently by Dr. Duncan Mackenzie, had some points in common with them, but they also had quite special features of their own, and it did not appear to the author that there was any real connection between the dolmens of the Oise and those of Sweden or Sardinia, as several other kinds of dolmens seemed to bar the way between them. His general conclusion was that the building of dolmens was not confined to one race and the building of circles to another, nor that there was any one race which originated or diffused both, but rather that megalithic construction was a phase of culture through which many races have passed and which was developed in different ways, not only by separate races, but also, in very restricted areas, by different tribes, without regard to any racial differences or connections between them.—Dr. J. S. **Holden**: The existence of a Palæolithic bed beneath the glacial Boulder-clay in south-west Suffolk. The implements were discovered in a well sinking at a depth of 100 feet in a seam of unrolled gravels beneath the blue Boulder-clay. The finding of these rude implements *in situ* beneath the glacial Boulder-clays is of considerable importance, as they are evidence of the existence of man on this old land surface probably long before the beginning of the Glacial period. In the discussion, although doubt was expressed as to the artificial character of the implements by some of the speakers, the general opinion was that they were of human workmanship.

Mathematical Society, February 10.—Sir W. D. Niven, president, in the chair.—H. W. **Richmond**: Note on double-sixes of lines.—Dr. H. F. **Baker**: Notes on the theory of functions. (1) On a certain logical principle; (2) on the establishment of the order of a doubly periodic function; (3) two queries.—Prof. H. **Lamb**: The diffraction of a solitary wave.

EDINBURGH.

Royal Society, January 10.—Dr. James Burgess, vice-president, in the chair.—E. M. **Wedderburn**: Current measurements in Loch Garry. The measurements were made with an Ekman current meter. The general conclusions drawn from the Loch Ness observations were confirmed. At the end of the lake the currents were not very uniform, but some very steady currents were observed at the centre. The return current was strongest just above the temperature discontinuity, and at the bottom indications were obtained of currents in the same direction as the wind. The currents were most uniform with moderate and steady winds. In stormy weather they were very variable, both in direction and in velocity.—John **McWhan**: Observations on some spark-gap phenomena. The paper described a number of curious effects produced by and on sheets of dielectrics interposed in various ways in the path of the electric discharge in air. Many of these depended on the fact that the electrodes were not in the line of the spark. In some the dielectric was perforated, in others it was driven in a definite direction with or without rotation, as the case might be, and in other cases the accompanying luminous effects with the brush discharge were very remarkable. The phenomena could not be co-ordinated on any of the ordinarily accepted theories.—Dr. G. A. **Carse** and D. **MacOwan**: Earth-air electric current and atmospheric potential gradient near Edinburgh. The observations were made with Wilson's portable electrometer. The values of the earth-air current in the town were found to be about one-tenth of those got by

Mr. Wilson at Peebles; at the Blackford Hill, just outside the city on the south, the value was about three times as great as in the city, and at an intermediate station intermediate values were found.—Dr. J. S. **Thomson**: Alcyonaria from the Cape of Good Hope, part i. The paper contained a description of thirteen species obtained off the shore in depths varying from 10 to 70 fathoms. Six were new to science, and one new genus was recorded.—Prof. J. T. **Morrison**: Notes on proposed meteorological instruments. The one was a self-recording anemometer capable of giving at once the north-south and east-west components of the wind's velocity. This was to be accomplished by use of a sphere which, by means of appropriate gearing, was kept rotating at a rate proportional to the wind velocity, while its horizontal axis of rotation was so connected to the vane as to point along the direction of the wind. Two small discs, equidistant from and respectively north and east of the vertical line through the centre of the sphere and pressed against the lower surface, would then rotate with the sphere and thus record the two components. The other instrument was a modified air thermometer, which could be set by comparison with a contiguous Six's thermometer in such a way that the reading gave at once the barometric pressure. The instrument was portable, and was intended to take the place of the aneroid, one of the most untrustworthy of all instruments used by travellers.

January 24.—Prof. Ewart, vice-president, in the chair.—Dr. Williamina **Abel**: The development of the autonomic nervous mechanism in the alimentary canal of the bird. In the wall of the alimentary canal there are various nerve plexuses and ganglia arranged in two layers, the function of which is to control and regulate the movements of the intestine. Are these nerve structures developed *in situ* or are they outgrowths from the central nervous system? From the point of view of physiological experiment the balance of evidence is in favour of the first view, the work of Bayliss, Starling, Langley, Elliot and others pointing to the possession of peculiar properties which separate these intestinal plexuses off fundamentally from the nerve elements of the central nervous system. The evidence afforded by histological examination of the developing embryo is, however, for the most part in favour of the second view. His, senior, Onodi, and His, junior, all support the outgrowth theory as a result of investigations made by them on the relationship of the visceral nerve supply to the central nervous system. It seemed desirable to repeat the investigations with the use of the modification of the silver nitrate staining method introduced by Ramon y Cajal. The material used was embryonic chicks varying in age from two to seven days' incubation. The work was carried out in the physiological laboratory of Glasgow University, and led to the conclusion that the autonomic nerve mechanism in the alimentary canal is formed as an outgrowth from the central nervous system. This view, which receives the support of different histologists, would suggest that the peculiar properties to the autonomic nerve mechanism of the alimentary canal were secondary in development to that of the cells.—J. J. **Simpson**: A new species of Cactogorgia. This specimen, which differed in certain specific characters from other known forms of Alcyonaria, was one of the collection in the Royal Scottish Museum. Unfortunately, there was no label of any kind or mention of the locality where it had been found.—Dr. J. **Oliver**: The stimulatory action of the oosperm in the uterus.—Dr. J. **Brownlee**: The significance of the correlation coefficients applied to Mendelian distributions. This paper gave an account of the manner in which the values of the correlation coefficient varied according to the method of calculation when populations of parent and offspring obtained on the Mendelian hypothesis were examined, and it was shown that in cases of dominance the four-fold division method gave higher correlation values than the product method. The effect of different forms of assortive mating on the correlation coefficient was also shown, and from one form of assortive mating a series of hereditary correlation coefficients were obtained identical with those found from observation. The effect of selective mating was considered, and the forms of selective mating which raised were distinguished from those which lowered the correlation coefficient. The correlation coefficient from parent to offspring when three races mix instead of two was also investigated, and the values of the coefficient in this case found to be considerably higher. Fraternal correlation was found to be considerably increased by assortive mating, and in certain cases by selective mating, while in the case of a mixture of more than two races further increase took place. These theoretical deductions were illustrated by cases of inheritance of colour in animals.

PARIS.

Academy of Sciences, February 7.—M. Émile Picard in the chair.—D. **Gernez**: A means of restoring phosphorescent properties to the sulphides of the alkaline earths. A sulphide of strontium, which immediately after its preparation phosphoresced brilliantly, slowly lost this property on exposure to air, but regained its phosphorescence on heating to redness in a current of hydrogen. This regeneration of the phosphorescence also takes place with barium sulphide.—M. van der Waals was elected a foreign associate.—M. **Luizet** and J. **Guillaume**: Observations of the Innes comet (1910*a*) made at the Observatory of Lyons. Results for January 26, 29, 30, and 31.—MM. **Javelle, Charlois,** and **Schaumasse**: The comet 1910*a*. Observations made at Nice. Data given for January 25, 26, 27, February 1, 2, 3. The comet has a round, well-defined nucleus 10″ in diameter.—M. **Borrelly**: Observations of the comet 1910*a* made at the Observatory of Marseilles with the comet finder of 16 cm. aperture. Data given for January 25, 26, 27, 29, 30, and February 1 and 3.—M. **Coggia**: Observations of the comet 1910*a* made at the Observatory of Marseilles with the Eichens equatorial of 26 cm. aperture. Results for January 25, 26, 29, 30, and February 1 and 3.—MM. **Claude, Ferrié,** and **Driencourt**: The comparison of chronometers or clocks at a distance by the method of coincidences by means of radio-telegraphic signals. Details are given of the mode of transmission of the signals. The method was tested between the observatories of Paris and Montsouris. The errors are less than 0·01 second. Further comparisons will be carried out between Paris and Brest as soon as the damage done to the apparatus at the Eiffel Tower by the floods has been repaired.—A. **Demoulin**: The K systems and congruences.—Johannes **Mollerup**: A remark on integral equations of the first species.—Nicolas **Kryloff**: Developments following hypergeometric polynomials.—Michel **Plancherel**: The representation of an arbitrary function by a definite integral.—Richard **Birkeland**: Some irregular integrals of linear differential equations.—A. **Étévé**: Autorotation. An explanation of an experiment due to M. Riaboutschinsky.—C. E. **Guye** and S. **Ratnovsky**: The variation of the inertia of the electron as a function of the velocity in the kathode rays and on the principle of relativity. The experimental results are compared in parallel columns with the figures calculated from the hypotheses of Lorentz and with those calculated from Abraham's formula. The deviations from the Lorentz are about 1 to 2 per cent., 16 being positive and 11 negative. The divergences from the Abraham formula amount to nearly 4 per cent., 26 being positive and 1 negative. Hence it is clear that the Lorentz formula alone is compatible with the experimental results.—G. A. **Hemsalech** and C. **de Watteville**: The high-temperature flame spectrum of iron. The temperature used was that of the oxyacetylene blow-pipe. The spectrum is very nearly the same as that obtained with the oxyhydrogen blow-pipe, except that the intensity of all the lines is so much increased that an exposure of ten minutes is sufficient to give the image of a well-developed spectrum.—M. **Guilleminot**: The radiochroism of organic bodies towards the α, β, and γ rays of radium and the X-rays.—Louis **Dunoyer**: The emission of electric charges by the alkaline metals. A repetition of an experiment due to J. J. Thomson on the emission of negative corpuscles by rubidium. The author thinks that the assumption of the spontaneous explosion of some atoms, analogous to the destruction of radio-active atoms, is not necessary for the explanation of the facts observed.—Louis **Nomblot**: The reduction of the nitroso derivatives of acetyl- and benzoyl-hydrazobenzene. Various attempts to produce triazane derivatives by the reduction of these compounds with hydrazine hydrate, aluminium amalgam, and zinc powder

were unsuccessful.—A. **Trillat**: Disinfection by incomplete combustion.—F. **Bordas** and M. **Touplain**: Contribution to the study of the reactions due to the colloidal state of milk. The authors think that their results demonstrate the uselessness of assuming the intervention of anæroxydases, catalases, &c., to explain the phenomena of the decomposition of hydrogen peroxide in milk.—MM. **Maurain** and **Warcollier**: The action of the ultra-violet rays on wine in course of fermentation. It is shown that the sterilisation of white wine is easier than cider.—J. **Chevalier**: The influence of culture on the amount of alkaloids in some Solanaceæ. In the cultivation of belladonna the addition of phosphatic or potash manures did not cause any addition to the alkaloid percentage; the amount of the latter is considerably increased, however, by the use of nitrogenous manures, a mixture of nitrates and farmyard manure giving the best results.—M. **Hegyi**: Some observations on the black scab of the potato. This disease, which has caused great damage to the potato crops in Hungary and Germany, has been attributed to *Bacillus phytophthorus*, propagated by infected tubercles. The author's observations have led to the conclusion that the disease is not propagated by the tubercles, but is due to the bacteria of the soil penetrating through lesions into the interior of the stem.—M. **Doyon**: The formation in the liver of an anti-coagulating substance under the influence of an alkaloid.—A. **Rosenstiehl**: The consequences of Young's theory. Chromatic construction in space.—Louis **Roule**: Fishes of the family of Nemichthyides.—E. **Vasticar**: The structure of the tectoria.—H. **Vincent**: The experimental bases of anti-typhoid vaccination.—H. **Carré**: The etiology of intestinal congestion in the horse.—L. **Cayeux**: The limestone algæ of the Girvanella group, and the formation of ooliths.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 17.

ROYAL SOCIETY, at 4.30.—Phosphorescence produced by α- and β-Rays: E. Marsden.—Theory of the Luminosity produced in Certain Substances by α-Rays: Prof. E. Rutherford, F.R.S.—(*a*) The Scattering of the α-Particles by Matter; (*b*) The Ionisation produced by an α-Particle. Part II.: Connection between Ionisation and Absorption: Dr. H. Geiger.—The Influence of Pressure on the Boiling Points of Metals: H. C. Greenwood.—On the Viscosities of the Gases of the Argon Group: A. O. Rankine.

ROYAL INSTITUTION, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Plum-moths of the Seychelles Expedition: T. B. Fletcher, R.N.—Die von Herrn Hugh Scott, auf den Seychellen gesammelten Embiidinen, Coniopterygiden und Hemerobiideen: Dr. G. Enderlein.—Die Termiten der Seychellen-Region: Dr. Nils Hohngreen.—On the Land and Amphibious Decapoda of Aldabra: L. A. Borradaile.

ROYAL SOCIETY OF ARTS, at 4.30.—The Bombay Housing Question: G. O. W. Dunn.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Head Hunters in Assam: T. C. Hodson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Clocks: F. Hope-Jones.

FRIDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 9.—Halley's Comet: Prof. H. H. Turner, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—*Further discussion*: Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when Exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, FEBRUARY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in and around Lake Chad: Captain J. Tilho.

ROYAL SOCIETY OF ARTS, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S.

VICTORIA INSTITUTE, at 4.30.—Arianism in its Bearing on Modern Questions: Prof. H. M. Gwatkin.

TUESDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Notes on the Northern Albanians: Miss M. Edith Durham.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Hudson River Tunnels of the Hudson and Manhattan Railroad Company: C. M. Jacobs.

WEDNESDAY, FEBRUARY 23.

GEOLOGICAL SOCIETY, at 8.—Metamorphism around the Ross of Mull Granite: T. O. Bosworth.

ROYAL SOCIETY OF ARTS, at 8.—Oxy-acetylene Welding: H. S. Smith.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

ROYAL METEOROLOGICAL SOCIETY (in the Physical Laboratory of the University of Manchester), at 5.—Investigation of the Electrical State of the Upper Atmosphere made at the Howard Estate Observatory, Glossop: Dr. W. Makower, A. J. Makower, and Miss M. White.—Results of the Hourly Registering-balloon Ascents from Manchester, June 2 and 3, 1909: W. A. Harwood.—Line Squalls and Associated Phenomena: R. G. K. Lempfert and R. Corless.

THURSDAY, FEBRUARY 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Colour-blindness and the Trichromatic Theory of Colour Vision: Sir William Abney, K.C.B., F.R.S.—Contributions to the Biochemistry of Growth: (*a*) The Total Nitrogen Metabolism of Rats bearing Malignant New Growths; (*b*) Distribution of Nitrogenous Substances in Tumour and Somatic Tissue: W. Cramer and H. Pringle.—The Alcoholic Ferment of Yeast Juice: Part V., The Function of Phosphates in Alcoholic Fermentation: Dr. A. Harden, F.R.S., and W. J. Young.—And other Papers.

ROYAL INSTITUTION, at 3.—Illumination, Natural and Artificial: Prof. S. P. Thompson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 9.—Colours of Sea and Sky: Lord Rayleigh, O.M., F.R.S.

PHYSICAL SOCIETY, at 5.—Telephone Circuits: Prof. J. Perry, F.R.S.—On the Laws regarding the Direction of Thermo-electric Currents enunciated by M. Thomas: Prof. C. H. Lees, F.R.S.—A New Method of Determining Thermal Conductivity: H. R. Nettleton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 3. Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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