THURSDAY, JULY 8, 1909.

RUWENZORI AND CENTRAL AFRICA.

(1) *Il Ruwenzori: parte scientifica: risultati delle osservazioni e studi compiuti sul materiale raccolto dalla spedizione di S.A.R. il Principe Luigi Amedeo di Savoia, Duca degli Abruzzi.* Vol. i., Zoologia e Botanica. Pp. vii+603; 74 plates. Vol. ii., Geologia, Petrografia e Mineralogia. Pp. xxi+286; 40 plates. (Milan: Ulrico Hoepli, 1909.) Price, 2 vols, 50 lire.

(2) *Résultats scientifiques des Voyages en Afrique d'Édouard Foà.* Publiés sous les Auspices du Muséum d'Histoire naturelle. Avec Préface de M. Edmond Perrier. Pp. xli+742. (Paris: Imprimerie Nationale, and Plon-Nourrit et Cie., 1908.)

(1) IN 1906 the Duke of the Abruzzi, already famous for his exploration of the lofty mountains of Alaska, resolved to do what no other traveller had done—make a thorough examination of the range of snow mountains in equatorial Africa known as "Ruwenzori." The number of snow peaks, their altitudes, extent of glaciation, and exact position on the map remained still unknown, although Ruwenzori had been revealed to geographical knowledge for nearly twenty years. Although no previous explorers had had the monetary resources of this prince of the House of Savoy, and consequently been able to fit out such a perfectly organised expedition, yet it must be noted that most of the Duke's predecessors suffered from sheer bad luck in the way of weather, or difficulties arising from the disturbed condition of the natives. Otherwise the Duke of the Abruzzi might have been forestalled as conqueror of these virgin peaks. But in any case it is doubtful whether any previous traveller was so perfectly trained to make every use of his opportunities as the Duke of the Abruzzi, who, apart from his carefully chosen staff, selected to deal specially with geology, biology, and photography, was himself a highly trained surveyor, scientific geographer, and alpinist.

The result has been, of course, a complete settlement of the position, height, configuration, and petrological structure of these "Mountains of the Moon"—not, as we now learn, the highest point on the African continent—in that respect they are only third in rank—but surely the most impressive and remarkable among African mountains. The general geographical and meteorological results of the expedition were given in one large volume at the close of 1908 (published in English and Italian). In the two volumes under review, the geological and biological collections and observations of the Duke's expedition are dealt with by a large number of authors, the whole work being edited by Dr. Alessandro Roccati (who has also written on the geology and petrology) and published in Italian only. The volumes are magnificently produced, and are of the highest importance scientifically. They deal justly, even generously, with the work of previous explorers, or with the opinions and researches of British, French, and German authorities (*inter alios*); but why did not Dr. Roccati get some one to go carefully through the proof sheets with him before publication? The two volumes abound in the most ridiculous press errors, wherever the Latin, English, German, or French languages are employed. English is the worst maltreated. The English authors quoted are sometimes made to express themselves in a very puzzling manner.

Ruwenzori was shown by the Abruzzi expedition to be a mountain chain mainly of archæan, crystalline rocks (gneiss, mica-schists, granite, &c.), cut athwart by a curved band of Palæozoic volcanic greenstones (amphibolite, diorite, diabase, &c.). In the upper valleys of the Bujuku, Mubuku, Mahoma, and other streams, born from the snow peaks and the glaciers, there is a lacustrine alluvium (which ought to be interesting of exploration for possible Pliocene or Pleistocene fossils). There are two or three calcareous deposits. The lower stream valleys are bordered by ancient and recent moraines. At the southern base of the Portal Peaks (south-east of Ruwenzori) there are three small dykes of basalt. Elsewhere in the distant foothills to the east and south of Ruwenzori there are plain evidences of recent volcanic activity in the intrusions of basalt, the stratified tuff, the craters of dead volcanoes (often filled with lovely crater lakes), the hot springs and the frequent earthquakes. This volcanic belt links on with the still smoking and devastated region of Mfumbiro and Lake Kivu, and is no doubt synchronous in origin with the volcanic activities of equatorial East Africa and of North Nyasa.

The work under review has much that is interesting to record on the former extension of the Ruwenzori glaciers. The volumes confirm the observations of Scott-Elliott, Moore, the present writer, and other travellers as to the signs of glacier action at comparatively low altitudes (7000 feet and less). If these deductions be correct, similar signs ought to be present (and should be looked for) on the Abyssinian, North Nyasa, Mlanje, Rhodesian, and Drakensberg Mountains. But if these indications of a Glacial period or periods are found in tropical Africa, and if, moreover, they are proved to be coincident in time with the Glacial periods of Europe and North America, will this not tend to dispose of the idea now in vogue that there has been a gradual shifting of the poles of the earth's axis, carrying with it the more or less glacial conditions gathered round the poles to various parts of the earth's surface? This last theory certainly explained more easily the former existence of a vegetation in both the present polar regions sufficiently dense to become transformed in course of time into coal-measures, a vegetation which could not have flourished with a six months' winter-night in every year.

Dr. Roccati thinks that Ruwenzori was at one time a lofty island of archæan rocks rising up out of the waters of an immense fresh-water sea—the Victoria Nyanza, Ibrahim (or Kioga), Albert Nyanza, Albert Edward, Dweru, and Semliki combined. He attributes this idea in its inception to the studies of Mr. C. W. Hobley, a Commissioner in the British East African service who has done so much to increase our knowledge of Equatorial Africa.

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The Duke of the Abruzzi established definitely the existence in the Ruwenzori range of six great *massifs* of snow-crowned, glaciated peaks. These are not placed in a continuous chain, but rather in a cluster, almost a broken amphitheatre, with Mts. Speke and Baker in the middle and the snowless Portal Peaks (11,000–12,000 feet) on the eastern side. It is from the south-east that the Ruwenzori giants are most broken down and most approachable. All the snow peaks are grouped within a few miles of one another, but beyond them, to the north, are lofty, snowless hummocks, perhaps rising to 9000 or 10,000 feet, which prolong the chain northwards in the direction of Lake Albert.

The loftiest of the snow-crowned *massifs* or mountains (Mt. Stanley) rises to 16,815 feet at its highest point (the Margherita Peak). The next highest *massif* is Mt. Speke (16,080 feet). After that Mt. Baker (15,988 feet), Mt. Emin (15,797 feet), Mt. Gessi (15,647 feet), and Mt. Luigi di Savoia (15,299 feet).

In possessing all these separate snow-crowned *massifs*, Ruwenzori differs from Kilimanjaro (with only two) and Kenya (only one), besides in the fact that its origin is due to a slow upheaval of the earth's crust, and not—as is the case with the other two great snow mountains of Africa, and their neighbours, Meru and Elgon—to an outburst of volcanic energy.

In the zoological collection made by the Duke was a fine specimen of a leopard obtained at Bujongolo (about 12,000 feet altitude), on the east side of Ruwenzori. It measured about 7 feet 2 inches in total length, and of this measurement the tail only occupied about 2 feet 3 inches. These are rather the proportions in tail and body of a jaguar than of a leopard. The markings, moreover, in the large size and completeness of the rosettes recall the jaguarine type, and still more the boldly marked leopards of Sinai, Persia, and China, and the Central Asian Ounce. The canine teeth in *Felis pardus ruwenzorii* are proportionately much longer than in other African leopards (except in one example from the Abyssinian Mountains). In this point (but not in skull peculiarities) the Ruwenzori leopard resembles the peculiar "*fontanieri*" leopard of China. Prof. Lorenzo Camerano, who describes *F. pardus ruwenzorii*, does not seem to be aware that Mr. Lydekker a year or so ago described a similar type from the Toro country at the north-east base of Ruwenzori. The present writer also saw a large leopard skin of this description in the possession of the Rev. Mr. Teggart (C.M.S.) in eastern Toro in June, 1900. This skin appears in the background of a seated man on p. 587 of the "Uganda Protectorate."

The second volume of "Il Ruwenzori" contains a good deal of interesting material on the subject of the Colobus monkeys (a group which seem to retain points of affinity with the Semnopithecines of Asia, the Archæolemurine forms of Madagascar, and even the Cebidæ of America); of Grant's zebra, and the classification of the "quagga" subgenus of equines; of the Central African buffaloes; and of the squirrels, dormice, mice, and crested rats (Lophuromys) of Ruwenzori. A few new birds are described, and numerous molluscs. A noteworthy contribution to "Il Ruwenzori" is Prof. F. Silvestri's essay on the Myriapoda—the Diplopoda especially—obtained by the Abruzzi expedition.

A very large and important collection was also made of earthworms and of parasitic worms, the latter derived from the intestines of beasts, birds, and reptiles.

The botanical section of this work is also of high interest, as it illustrates very conclusively the alpine and subtropical flora of Ruwenzori—the giant groundsels, strange lobelias, the heaths, junipers, and ferns—filling up many gaps left in the work of previous travellers.

(2) Not equally valuable in the scientific study of Africa is the work so sumptuously produced by the Paris Museum of Natural History. The results of M. Édouard Foà's journeys, to have acquired proper significance and reward from the public interested in African geography and ethnology, should have been published ten years ago. His remarks would then have been more apposite; his discoveries would not have been forestalled by later and more scientific travellers. As it is, M. Foà was at no time what might be called a trained observer, except in regard to astronomical and meteorological observations and records. His ethnology and his natural history strike the critical reader as hazy, inexact, too generalised, too little founded on direct personal observation, too much influenced by traditional opinions. His vocabularies of native languages are full of errors, and are, moreover, quite displaced in interest by the serious treatment of these Zambezian, Central African, and East Congo languages by a host of British, French, and Belgian missionaries and officials. Amongst inaccuracies, too (perhaps on the part of the editors), is the presentation of an obvious Bushman (pp. 142 and 143) as a Yao. [The original of this mis-named picture is in the possession of the Royal Anthropological Institute.] Some of the notes on the Bushmen would be interesting and valuable were they not so devoid of actuality, of names, places, and dates. Apparently M. Foà did encounter some of the mysterious "Vaalpens" in the valley of the northern Limpopo (though he does not give them that name—see pp. 113, 114), a race the existence of which (as a "pygmy" type distinct from the Bushman) has been asserted by Prof. Keane and denied by Mr. Selous. It is interesting to note that M. Foà comments on the complete absence of steatopygy among these north Limpopo Bushmen (? Vaalpens), and the rest of his description rather accords with what Prof. Keane has collected relative to the Vaalpens.

There are portions of M. Foà's essays on the lion and the African elephant which strike one as new, interesting, and derived from original observation, mixed up, however, with much unnecessary padding. He is able to supply two good photographs of the rare Angas's Tragelaph and some fresh information about that handsome creature. He discovered in Central Zambezia what is probably a new subspecies of Burchell's zebra (or, as Mr. R. I. Pocock would say, quagga), which seems in its narrow striping an intermediate form between the zebra and the quagga groups (see also on this subject "Il

Ruwenzori "). M. Foà made considerable collections of fish in Central Africa, of mollusca, insects, spiders, ticks, and crustaceans. He also brought back Medusæ from Tanganyika. These Medusæ serve as a text for a very interesting article by M. Charles Gravier on the Medusæ of the Victoria Nyanza, of Tanganyika, and of the Niger basin. Perhaps the most important contribution to this *recueil* is the treatise by M. Louis Germain on the molluscs of Tanganyika, notably those collected by M. Foà. M. Foà's own remarks on the tsetse fly are worthy of attention. H. H. JOHNSTON.

THE PLANET MARS, 1890–1901.

La Planète Mars et ses Conditions d'Habitabilité. By Camille Flammarion. Tome ii., Observations faites de 1890 à 1901. Pp. 604. (Paris: Gauthier Villars, 1909.) Price 12 francs.

IN the year 1893 we had the great pleasure of giving our readers some account (vol. xlvii., p. 553) of the very excellent and complete summary of the observations of the planet Mars, made between the epochs 1636–1890, compiled by the distinguished French astronomer, Monsieur Camille Flammarion. This work, containing no fewer than 604 pages, presented us with a most interesting survey of the progress made in enumerating and deciphering the markings observed on the planet's surface. It commenced with the earliest known observation of the planet, namely, that of the Neapolitan astronomer Fontana, on August 24, 1638, who wrote:—

"1636. Martis figura perfecte spherica distincte atque clare conspiciebatur. Item in medio atrum habebat conum instar nigerrimæ pilulæ.

"Martis circulus discolor, sed in concava parte ignitus deprehendebatur.

"Sole excepto, reliquis aliis planetis, semper Mars candentior demonstratur."

The volume concluded with the observations made in the year 1890, including the first photographs of the disc of Mars made by Prof. W. H. Pickering at Mount Wilson, California, on April 9.

In Martian cartography the year 1890 seems to-day a very long time ago. The pioneers did their work well, and the great tradition which fell on the shoulders of those who were busy with Mars up to 1890 was well maintained, and a great amount of new knowledge secured. Since that year the attack on the planet, to unravel the secrets of its visible features, has been no less severe, and to-day the knowledge gained is only a new incentive to further research.

If we were to be asked to state three or four of the more recent and most important discoveries in relation to the planet Mars, we should be inclined to say as follows:—

(1) That the dark areas on the planet which were considered to be seas have been shown to be traversed by permanent lines, and that, therefore, the water surface explanation had to be abandoned (Pickering and Douglas, 1892).

(2) The successive development of the canals according to the Martian seasons (Lowell).

(3) The photography of the canals themselves (Lampland, 1903–5).

(4) The photography of the spectrum of water vapour in the Martian atmosphere (Slipher, 1908).

While the above may be considered as four of the important results secured since 1890, there is a host of many other valuable advances which will be found recorded in the volume under review.

Monsieur Flammarion has done his work exceedingly well, and, with masterly instinct, describes, fits together, and discusses the observations, made between the years 1890 and 1901 by a very great number of workers, in a logical and interesting manner.

Before commencing to give in detail the observations of the first epoch, 1892, he rightly refers at some length to the fine memoir published in 1896 by the celebrated Italian astronomer, M. Schiaparelli, the discoverer of the canals. This memoir is devoted to a discussion of his observations of the Opposition 1883–4, while a sixth memoir, published in 1899 and here referred to, contains his observations made at the Opposition of 1888.

Space does not allow us, nor indeed is it necessary, to enter into any detail into the successive series of observations which are here marshalled together. The reader must be left to peruse the volume himself and form his own conclusions, but even he will be astonished at the wealth of matter which is brought together under one cover.

As in the previous work, there is a great number of illustrations accompanying the text, and these add materially to the understanding of the changes of Martian features.

At the end of the volume, M. Flammarion, with the help of M. Antoniadi, has constructed a key-map of the surface features of the planet, which gives us an idea of the complicated system of markings which is the result of the observations up to the year 1901.

As has been mentioned above, some important additions to our knowledge of Mars have resulted from observations of more recent date, and we can only suppose that M. Flammarion has in hand vol. iii., which will, we hope, in due course be published, and be as valuable a contribution to astronomical science as its two predecessors.

In conclusion, we may quote M. Flammarion's remarks with regard to the habitability of Mars, since the subject has recently been prominently brought forward:—

"Mais il me semble que, dans toutes ces interprétations, je suis moi-même un peu terrestre. Il y a sans doute là d'autres éléments, non terrestres, mais *martiens*, ou, tout au moins, des conditions toutes différentes de celles de notre habitation. Que cette planète soit actuellement le siège de la vie, c'est ce dont témoignent toutes les observations. Mais il nous est encore impossible de nous former aucune idée judicieuse sur les formes que cette vie a pu revêtir, formes assurément differentes de nôtres. Un mystère impénétrable enveloppe encore aujourd'hui ce passionnant problème, qui est, en définitive, quoi qu'on en passe, le but, peut-être inaccessible, de toutes les recherches de l'Astronomie planétaire. Mais ne désespérons jamais! Qui sait ce qui sommeille dans l'inconnu de l'avenir?"

WILLIAM J. S. LOCKYER.

THE GEOMETRY OF FORCES.

Geometrie der Kräfte. By H. E. Timerding. Pp. xii+381. (Leipzig: B. G. Teubner, 1908.) Price 16 marks.

IN this admirable volume Prof. Timerding gives a systematic and original treatment of the geometry of forces and force-systems in which for the first time, so far as we are aware, an adequate knowledge of modern geometrical research has been utilised in a text-book of mechanics.

Ever since the great work of Plücker, that large and most attractive department of mathematics known as the geometry of the linear complex has been found to be intimately connected with the geometry of forces. It is sufficient to recall the fact that whenever six forces applied to a free body are in equilibrium, the forces must lie respectively on six rays of a linear complex. In chapters viii. and ix. of Timerding's book now before us we have an admirable treatment of the application of the theory of the linear complex to the theory of systems of forces. The many interesting matters set forth in these pages show how greatly the advancement both of the geometrical theory and the dynamical theory is promoted by their association.

The statical and dynamical significance of the linear complex is closely connected with the fact that each ray of the complex is reciprocal to that screw of which the axis is the axis of the complex, while the pitch of the screw is the parameter of the complex. Many of the geometrical properties of the complex follow directly from this general principle. For example, on p. 107 it is shown that four linear complexes have two real or imaginary rays in common. This is an immediate consequence of the fact that one cylindroid can always be found of which every screw is reciprocal to any four given screws. As there are two screws of zero pitch on the cylindroid, these lines are, of course, the two common rays of the four linear complexes defined as being reciprocal to each of the given screws. We congratulate Prof. Timerding on his recognition of the proper place for the linear complex in the forefront of a text-book on the geometry of forces.

The theory of screws has received in this volume a treatment even more ample than that which it has already received in the works of Fiedler, Schell, Budde, Minchin, and more recently in the "Encyclopädie der mathematischen Wissenschaften." The excellent work of Harry Gravelius, "Theoretische Mechanik Starrer Systeme," contains a complete account of the theory of screws up to the date of its publication in 1889. Much of the work done on the subject in the succeeding decade has been available for the "Geometrie der Kräfte." It may, however, be remarked that certain developments of the theory which have appeared since 1900 have not been included in Prof. Timerding's volume. The theory of screw-chains, by which the theory of screws has been extended to any material system, is also not discussed. A suggestive reason for this omission is given in the preface (p. vii), where Prof. Timerding says that, in his opinion, the theory of screw-chains would require a new and voluminous treatment of the whole of mechanics in which the rigid body would appear as the first element.

Observing that the laws for the composition of twists and wrenches are identical, the author, as others have done, uses the word *dyname* to signify either a twist or a wrench. For a large part of the subject the use of the abstraction signified by the word dyname is very convenient, and considerable use has been made of the important labours of Study on the geometrical theory of dynames.

In an interesting chapter on "Die Reyeschen Strahlencomplexe" the author brings into its due prominence the fundamental importance of the "Geometrie der Lage" in kinematics. This chapter contains many admirable theorems, and we could only wish that such instructive and beautiful ideas as are here set forth were more generally introduced into the teaching of mechanics. Due acknowledgment is made throughout the work of the important contributions to the geometrical theory of forces by the late Prof. Charles J. Joly.

The chapter on the cylindroid may be specially commended, and prominence is given to the theorem that the projections of any point on the generators of a cylindroid lie on an ellipse. We may, however, note that the proof here set forth is not that by which the theorem was discovered, as shown in the original volume on the theory of screws published in 1876.

A sufficient account is given of the various systems of screw coordinates, and, following the analogy of the resolution of forces, Prof. Timerding uses notation which divides the coordinates of a screw into two groups of three each. It is, however, often convenient to use the six symmetrical coordinates of a screw referred to six co-reciprocal screws.

We are glad, indeed, to commend this most excellent work to the attention of teachers and students of theoretical dynamics. We are sure that if the book were translated into English it would form a very valuable supplement to the existing English books. It would give the student an adequate idea of the extent to which modern geometrical theory and the theory of forces act and react on each other to the vast benefit of both. ROBERT S. BALL.

THE DISTRIBUTION OF GOLD ORES.

Gold: Its Geological Occurrence and Geographical Distribution. By J. Malcolm Maclaren. Pp. xxiii+687. (London: *The Mining Journal,* 1908.) Price 25*s*. net.

DR. MACLAREN begins his preface with the remark that "the writer who would add one more treatise to the literature of the study of ore-deposits must needs show justification." Any apology for the publication of his useful book is, however, quite unnecessary, for the increase by four times of the gold yield of the world during twenty years has been attended by a voluminous and scattered literature. Students of mining geology will be grateful to any author who undertakes the great labour of compiling a summary of recent work on gold and its distribution.

The longest and most valuable section of Dr. Maclaren's book is occupied by an account of the geological structure and mining history of all the chief goldfields of the world. This part of the work occupies 544 pages. The goldfields are classified by continents. Those of Europe are described first, and in proportion to their economic importance receive longer notice than those of Australia and South Africa. The longest section is that on the goldfields of North America. Each field is noticed separately; the descriptions are necessarily short, but they are concise, and are accompanied by useful reference to recent literature. The minor fields are described at relatively greater length than the others; and thus Kalgurli, with its "Golden Nile," is dismissed in four pages, including a full-page map and another figure. This distribution of space is, however, probably the most useful, as the less-known fields are often very instructive and their literature is less accessible. The author has travelled extensively, and his accounts of many fields have the advantage of personal knowledge and original information. The descriptions of the fields are therefore inevitably of unequal merit.

Among the most interesting sections are those on the mines of New Zealand—though as a New Zealander, it is strange that the author places Reefton in Westland, and spells the name of the founder of the New Zealand school of mining geologists Uhlrich—of Queensland (the author was once on the staff of its Geological Survey), and of Mysore. The historical introduction to the Mysore gold mines is of especial interest, and the author rejects the view that the ancient mines there can have been those from which Solomon and the Phœnicians obtained their supplies of gold. Dr. Maclaren remarks that India was then a civilised State, which needed more gold than it produced; and the Israelites could only have obtained gold there by barter, for which they had nothing to offer. This conclusion, therefore, strengthens the view that the Ophir of the Phœnicians must be in southern Africa, and that the gold probably came from the prehistoric mines of Rhodesia.

Dr. Maclaren's account of the separate goldfields is preceded by an introduction on the chemical and physical properties of gold, on natural and artificial compounds of gold, and on the theories of the formation of gold ores. The speculative section of this introduction is remarkable for the author's advocacy of somewhat extreme positions. Thus he denies the origin of any important ore deposits by other agencies than meteoric waters. He admits that there may be some magmatic water; but even when he allows that the gold is due to magmatic emanations, he holds that the water in which it is dissolved comes from a superficial source. He also holds to the once popular view that alluvial gold and gold nuggets are formed by growth *in situ* in the gravels from percolating gold-bearing solutions. He defends this view especially on the ground of the crystalline character of much alluvial gold; he quotes competent authorities who deny this fact, but affirms it from his own experience. The author does not explain why, on this precipitation theory, nugget formation is so local, and why the nuggets are so constantly found just below the outcrop of reefs containing nuggety patches of gold. He admits that the nuggets of Western Australia are derived from gold-quartz veins, and the evidence for the similar origin of the nuggets from Victoria—which contains the most famous of nugget-yielding goldfields—seems to the writer overwhelming.

Another doubtful hypothesis advanced by the author is the absence of any undoubted, valuable pre-Cretaceous placer deposit. He rejects, or quotes with apparent approval those who reject, the alluvial origin of the gold in various Mesozoic, Palæozoic, and Archæan conglomerates and sedimentary deposits; and he then argues that the absence of pre-Cretaceous detrital gold is due to the rocks having been lowered into a zone saturated with alkaline waters which removed the gold in solution and re-deposited it in veins.

Though many geologists may be disposed to differ from the author in some of his conclusions as to the formation of gold ores, they will be no less grateful to him for this valuable and trustworthy summary of the voluminous gold literature issued during the past twenty years. J. W. G.

SWINE IN AMERICA.

Swine in America. A Text-book for the Breeder, Feeder, and Student. By F. D. Coburn. Pp. xv+614. (New York: Orange Judd Co.; London: Kegan Paul and Co., Ltd., 1909.)

JUST as it might be said of the British fat bullock that he has followed the turnip, so it might be said of the American fat hog that he has followed the corn, *i.e.* Indian corn. In the United States there are 56 millions of swine—there are only three and a half millions in the United Kingdom—and far more than half these are to be found in the great corn States which are drained by the Mississippi and its tributaries. Iowa comes first with 8½ millions, and Illinois and Nebraska next with 4½ and 4¼ millions. Altogether there are about eighty million pounds' worth of swine in the United States, the duty of which it is to convert corn and other crops and by-products into more marketable commodities, and eventually to feed, not only the Americans, but also some part of the industrial population and the armies and navies of the rest of the world.

An industry so vast can do with many a text-book, and Mr. Coburn has produced one for those who breed, rear, and feed the raw materials for the American packing houses. Many experiments have been carried out in the States on the rearing and fattening of swine, and the gist of these is embodied in Henry's "Feeds and Feeding," which, however, is a book dealing rather with principles than with the details of management, and a book, therefore, for the student rather than for the farmer. Mr. Coburn's is a farmer's book. He has collected Henry's and many other data, and set them forth in such a way that the nutritive effect and economic value of every important feeding stuff and by-product is dealt with, whether these foods are fed separately or with others. The effects of bulky and succulent foods and of concentrates, and of these consumed separately and jointly, are fully considered. Thus, for instance, a farmer having a lot of corn is told what proportion of alfalfa, or roots, ought to be fed along with corn to attain the best economic results. This part of Mr. Coburn's book is valuable.

In the earlier chapters Mr. Coburn deals with the various races and breeds of swine in the States, and also with the principles of breeding; but, as may be inferred from the following quotation, although he writes at some length, he does not get much beyond the current nebulous ideas held by stock-breeders on these subjects:—

"There exists in some sections of Old Mexico a type of 'hog' which is the product of crossing a ram and a sow, and the term 'Cuino' has been applied to this rather violent combination. The ram used as a sire to produce the Cuino is kept with the hogs from the time he is weaned. . . . The Cuino reproduces itself and is often crossed a second and third time with a ram."

A number of the illustrations are not accurate representations of the breeds they refer to, but are rather artist's ideals.

OUR BOOK SHELF.

A Text-book of General Pathology for the Use of Students and Practitioners. By Prof. J. M. Beattie and W. E. Carnegie Dickson. Pp. xvi+475. (London: Rebman, Limited, 1908.) Price 17*s.* 6*d.* net.

IN the preface the authors state that this volume is based on the teaching of the Edinburgh school of pathology, where the first chair of pathology in the United Kingdom was founded, and as such we welcome its appearance. At the same time, we do not note any features particularly novel, either in the subject-matter or in its arrangement, and in some respects the book seems to be lacking as a text-book of general pathology. Thus the important factor of heredity in disease, and shock and collapse, are not even mentioned, and we do not understand why a discussion of the nature of gout and the chemistry of uric-acid metabolism "do not come within the scope of the present volume."

The opening chapter deals all too briefly with the cell in health and disease. An excellent summary of modern views on cell-structure and cell-division is presented to the reader, but the section on the chemistry of the cell is mainly occupied with the recommendations of the Chemical and Physiological Societies on protein nomenclature.

The chapters which follow deal respectively with general retrogressive processes, disturbances of the circulation, inflammation and repair, progressive tissue changes, animal parasites, and immunity.

An excellent account is given of fatty change, and modern views respecting it are succinctly stated. Lardaceous disease is similarly well treated, but we do not understand why authors will persist in employing the terms "waxy" and "amyloid" to designate it, for "lardaceous" has the claim of priority; it is official in the "Nomenclature of Diseases" of the Royal College of Physicians, and the material present is universally known as lardacein.

The chapter on inflammation and repair gives all essential details on this important subject. The classification of tumours, admittedly a difficult subject, adopted by the authors is that advocated by Adami. This seems to us unnecessarily complex for the medical student and practitioner. The structure of tumours is given at some length, and the chief views on the causation of tumours are summarised. As regards the latter, one or two points brought out by recent research have been omitted. For example, the occurrence of heterotype mitosis in malignant growths is referred to, but Bashford and Murray's criticism of Farmer, Moore, and Walker's work in this connection does not appear, and in discussing the supposed sarcomatous metamorphosis of carcinoma no mention is made of the fact, which now seems certain, that it is the connective tissue stroma of the carcinoma which is thus transformed, and ultimately overgrows the carcinomatous elements. The vegetable parasites are omitted, as these are dealt with in text-books of bacteriology, but an excellent and fairly full account is given of the animal parasites, protozoan and metazoan. Immunity is discussed in twenty-five pages, and the essentials of the subject are conveyed to the reader.

On the whole, the book may be regarded as a very useful text-book of general pathology. It is excellently got up, and a word of praise must be bestowed on the illustrations, 162 in number (also four coloured plates), the majority of which are the work of Mr. Richard Muir, and as a rule depict very clearly the subjects they represent, though it may be questioned whether so many are really necessary, as they tend to distract the student from an examination of the actual specimens themselves.

(1) *Der Bau des Weltalls.* By Prof. Dr. J. Scheiner. Dritte, verbesserte Auflage. Pp. 132. (Leipzig: B. G. Teubner, 1909.)

(2) *Die Planeten.* By Dr. Bruno Peter. Pp. 131. (Same publishers, 1909.) Price 1.25 marks each.

(1) THE series "Aus Natur und Geisteswelt" is well known. It consists of a number of little treatises, in which men of science occupying prominent positions have attempted to explain in an accurate and comprehensive manner the results of past inquiries, and the position to which our knowledge has extended in various directions. In the former of the two specimens before us, Dr. Scheiner gives the substance of six popular lectures delivered in Berlin to a number of high-school teachers in the course of which he attempted to describe so much of the universe as comes within the range of our telescopes. He endeavoured to bring home to his audience the magnificent scheme of distances on which the planetary and stellar systems are planned; he traced the detection of proper motion of the fixed stars, and showed how the sun's movement in direction and amount can be determined. The phenomena of the sun are explained in some detail, preparatory to the examination of the spectra of stars, a subject which is discussed somewhat fully, as might be expected from a member of the staff of the Potsdam Observatory. Herein, as the author points out, he is on the sure ground of observation. But in his last chapter he approaches the more speculative subject of the origin and constitution of the universe. The subject is handled with skill, and, notwithstanding the limited space to which the author is restricted, he has succeeded in making his subject both clear and interesting. We do not wonder that the little work has passed through three editions, for, apart from that longing to satisfy an intelligent curiosity which appeals to so many, the material is put in a very attractive form, which should appeal to many readers.

(2) Dr. Peter has a simpler subject, in which the facts have been many times detailed, and he has little scope for either originality of treatment or lucidity of arrangement. As the planets extend in order from the sun, so he must follow them from Mercury to Neptune. A Vulcan is hinted at within Mercury's orbit, but the

hypothetical planet outside Neptune does not attract comment. Since the satellites of Jupiter and Saturn come under notice, more attention might have been given to the moon and to the phenomena of eclipses. The plan of the book, however, aims rather at the description of the surface than of the motion of the planets, though naturally the tale of the discovery of Neptune is told once again. It might seem that there is scarcely room for such a book, considering the number of popular works that are extant, but there is some difficulty in keeping even these works abreast of the time. As an example we may quote the sentence, "Bestimmt sieben, wahrscheinlich sogar acht Monde umkreisen Jupiter." Notwithstanding the recent issue, there is here opportunity for correction in the next edition.

Untersuchung und Nachweis organischer Farbstoffe auf spektroskopischem Wege. By J. Formánek, with the collaboration of E. Grandmougin. Pp. 252. Second edition. Part i. (Berlin: Julius Springer, 1908.) Price 12 marks.

THE first edition of this work appeared in 1901 in a single volume. In part i. of the new edition which is now before us, subject-matter to which only forty-two pages were devoted in the first edition has been elaborated and added to so largely that it occupies the whole of part i. The introduction deals with spectroscopic methods in general, but more particularly with absorption spectra of coloured solutions and the influence of solvents, concentration, reagents, temperature, &c., on the latter. Then follow chapters on the spectroscope, general observations on the relationship between colour, absorption, fluorescence, and constitution of coloured compounds and dyestuffs, and on the relationship between chemical constitution and absorption spectra of dyestuffs belonging to individual classes. The latter include di- and tri-phenylmethane dyestuffs, quinonimide dyestuffs, fluorindene and triphendioxazine, acridine dyestuffs, and anthraquinone dyestuffs. No mention is made in this part of the azo-dyes, or the dyes of the indigo group, while of natural dyestuffs only alizarin is mentioned. It is to be presumed, however, that these important classes will receive due consideration in part ii., which represents the practical part of the work.

Although a vast amount of work has been done by different observers on the absorption spectra of the organic dyestuffs, the information is so scattered as to be difficult of access to the ordinary individual, and this is probably the main reason why this important subject has hitherto not received the attention which it merits. There is, however, ample testimony that this particular application of the spectroscope is being more and more appreciated by the manufacturers of dyestuffs on the one hand, and the users on the other. This is borne out by the fact that such an eminently practical body as the Société industrielle de Mulhouse has made a pecuniary grant to the author to enable him to publish the new edition. Prof. Formánek has made a life-long study of his subject, and a comprehensive and up-to-date book on this particular application of spectrum analysis, such as the present edition promises to be, would be much appreciated. It is to be hoped that the completion of the work will not be long delayed.

On the Calculation of Thermochemical Constants. By H. Stanley Redgrove. Pp. viii+102. (London: Edward Arnold, 1909.) Price 6s. net.

THERE are a number of physical properties of substances, *e.g.* molecular heat of combustion, refractivity, &c., which are chiefly additive in character, so that their values can be calculated if we know the necessary fundamental constants. It is, however, also well known that these properties, while still remaining additive, involve factors depending on the constitution of the molecule, *e.g.* method of linking, ring-formation, &c., all of which should be taken into account in the calculation of the value of the particular property in the case of any given substance. It is the thorough-going application of this principle in the calculation of thermochemical constants, extended so as to include, not only the specific thermochemical values of double and triple bonds, but also the thermal value of the "strain" in ring-compounds and of the single bond in chain-compounds, that the book under review expounds. The author's method of calculation has already appeared in several articles published in the *Chemical News*, on which the present monograph is based.

The author's method will best be understood from the following:—Let H be the value of a hydrogen atom *plus the link joining it to a carbon atom.* Let C be the value of a carbon atom, *not* including the value of its valencies; let L_1, L_2, L_3, be the values of the single, double, and triple bonds respectively. Knowing the constants for four hydrocarbons, it is possible to calculate the value of the following:—$C+4H=\alpha$, $2H-L_1=\beta$, $4H-L_2=\gamma$, $6H-L_3=\delta$. These are the "fundamental constants" for carbon and hydrogen. Moreover, the formula of any compound can be written in terms of these fundamental constants, and the theoretical value so obtained can then be compared with the experimental number.

This method the author has illustrated by the calculation of a large number of heats of combustion of substances belonging to different groups of compounds, and, with comparatively few exceptions, excellent concordance with the experimental numbers has been obtained. In this fact the method has its justification.

In an interesting section the author discusses also the relation between heats of combustion of ring-compounds and von Baeyer's strain theory, and he shows that in general there is perfect agreement. No simple relationship, however, has been obtained between the angle of deviation and the thermal equivalent.

The book is one which deserves and will no doubt obtain the attention of all who are interested in the relations between the thermochemistry of compounds and their chemical constitution; and the method of calculation is, moreover, one which will not improbably find application in the case of other physical properties of an additive character. It is an important addition to the literature of thermochemistry. A. F.

An Angler's Season. By W. Earl Hodgson. Pp. xii+299. (London: A. and C. Black, 1909.) Price 3s. 6d. net.

A BOOK from Mr. Hodgson is always worthy of the angler's attention, and "An Angler's Season" is no exception to the rule. Dealing as he does solely with salmon and trout, and almost entirely with Scotch waters, the author's season begins in January and ends in October, and to each month a chapter is allotted; throughout there is much good reading, a deal of sage advice, and some controversy. Early in February Mr. Hodgson is already at issue with the dry-fly fisherman, and his attack on the "Hampshire method" waxes furious, but he says nothing of those who fish with the dry fly in Aberdeenshire waters and find the method successful. Fault is also found with some anglers for their "habitual indifference to the weight of a basket" and their love of nature; surely an angler is no worse for also being a naturalist, or at least taking an interest in the natural history of fishes. A study of what naturalists have written would have shown the danger of Mr. Hodgson's theory that taking large fish only, and restoring all of smaller size to the water, would have the effect of increasing the average weight of the stock of fish in three years' time, and would, we think, have prevented the red flesh of some trout being attributed to richer feeding rather than to a differently constituted *menu*. We think, too, that the theory set forth to account for the absence of a run of salmon in some rivers of the east of Scotland in May, June, and July is somewhat strange, and cannot be maintained in the light of our present knowledge of the salmon's life-history.

There are throughout the book numerous practical hints of value upon such subjects as flies and baits, and as to the time and place for fishing under various conditions of water and weather; in the last chapter there is also a most thrilling tale of a riverside adventure. The illustrations, reproduced from photographs, are excellent, but are almost invariably separated by many pages from the corresponding text, and there is a good index. L. W. B.

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.*]

A New Departure in Seismology.

ON the photographic records obtained from British Association types of seismograph it has been noticed that when the films have been moving slowly (60 mm. per hour) there have been slight thickenings in the trace, while if the recording surface has been moving quickly (240 mm. per hour) the line which ought to be straight is slightly wavy. These irregularities, which have hitherto received but slight attention, are so small that they may be easily overlooked. When the thickenings were first observed it was supposed that their existence was due to a flickering at the source of light or to some irregularity in the movement of the record-receiving surface. When, however, it was observed that these markings frequently occurred at the same time at different stations, as, for example, at Shide and Bidston, the conclusion was that they were due to movements of the ground, and might be the surviving phases of large movements with origins at a distance.

A very good illustration of this is given by comparison of the times of occurrence of the after-shocks which followed the earthquake of January 14, 1907, in Jamaica, with the times at which suspicious irregularities were found on the seismographic traces at Shide and Bidston. Between January 14 and July 5, 148 shocks were noted in Jamaica. Forty-three minutes after the occurrence of fifty-one of these shocks irregularities were found on the films at the stations mentioned. As forty-three minutes is the time we should expect a "surface" wave to travel sixty-seven degrees, or from Jamaica to England, the inference is that the slight irregularities represent movements which had their origin in Jamaica. Corresponding markings, with the exception of one at Göttingen on July 5, do not appear in the registers from European stations, which are not more than six or seven degrees farther from Jamaica than Britain.

Another instance of the recording of after-shocks are the markings seen on seismograms after the disaster which, on December 28, 1908, ruined Messina and Reggio. Between December 29 and January 30 at Mileto, forty miles from Messina, 225 shocks were noted. Eight of these reached the Isle of Wight, while on January 1 and 13 at Göttingen, Hamburg, and Laibach, only two were noted. The reason that so small a number travelled a considerable distance indicates that the originating impulses were weak. That a larger number should be recorded in Britain than at comparatively near stations is not so clear.

With smoked paper recording surfaces, whether the multiplication of recording levers be 10 or 200, a certain slackness in joints and elasticity of pointers prevents any record of motion being obtained until a certain amplitude of ground motion has been reached. With photographic recording apparatus where a light source is far from a recording surface, a thick line may obscure any minute movement. These instruments are therefore unsuitable as recorders of very small movements. This, at any rate, has been my experience.

The British Association type of instrument, when properly adjusted and installed, does, however, pick up these neglected movements—a result which is shown very clearly in the registers for this year.

It seems to me that beneath observatories all over the world earth-messages may be passing every few minutes, but these are not recognised because instruments generally in use are not capable of recording the same. To investigate this possible new departure in seismology, old types of instruments will have to be improved or new ones adopted. JOHN MILNE.

Shide, Isle of Wight, July 2.

Tables of Bessel Functions.

A COMMITTEE of Section A of the British Association for the Advancement of Science, appointed to undertake the further tabulation of Bessel functions, is at present considering the advisability of unifying and completing the existing tables with the view of the publication of a complete table of Bessel functions.

The committee would be glad of information as to existing tables of Bessel and Neumann functions with a real or complex argument, in addition to the following, of which the members are already aware:—

(1) *Meissel's Tables* (reprinted in Gray and Mathews' treatise on Bessel functions) giving $J_0(x)$ and $J_1(x)$ from $x=0$ to $x=15{\cdot}5$ at intervals of 0·01 [12 places]; also a table of the first 50 roots of the equation $J_1(x)=0$ to 16 places.

(2) *British Association Tables* (1889, 1893, 1896 Reports) giving $I_0(x)$ and $I_1(x)$ from $x=0$ to $x=5{\cdot}1$ at intervals of 0·001 [9 places]; also $I_0(x)$ to $I_{11}(x)$ from $x=0$ to $x=6{\cdot}0$ at intervals of 0·2 [11 and 12 significant figures]; also a table of $J_0(x\sqrt{i})$ from $x=0$ to $x=6$ at intervals of 0·2 [9 places]. (Part of these tables are reprinted in Gray and Mathews.)

(3) *Tables of* $J_n(x)$ *in Gray and Mathews* from $n=0$ to $n=60$ and from $x=0$ to $x=24$ at intervals of unity [18 places].

(4) *B. A. Smith's Tables* giving $Y_0(x)$, $-Y_1(x)$, $(\log 2-\gamma)J_0(x)-Y_0(x)$ and $(\log 2-\gamma)J_1(x)-Y_1(x)$, from $x=0$ to $x=1{\cdot}00$ at intervals of 0·01 and from $x=1{\cdot}1$ to $x=10{\cdot}2$ at intervals of 0·1 [4 places: error not exceeding 2 in the last place]. (*Messenger of Maths.*, vol. xxvi., 1897, and *Phil. Mag.*, vol. xlv., 1898.)

(5) *Aldis' Tables* of $I_0(x)$, $I_1(x)$, $K_0(x)$, $K_1(x)$ from $x=0$ to $x=11$ at intervals of 0·1 [16 places]. (Roy. Soc. Proc., 1896 and 1899.)

(6) *J. G. Isherwood's Tables* of $K_0(x)$ to $K_{10}(x)$ from $x=0$ to $x=5$ at intervals of 0·2 [5 significant figures]. (Manchester Lit. and Phil. Soc., vol. xlviii., 1904.)

The committee will be grateful to be allowed, through the medium of NATURE, to invite any readers who are aware of the existence of tables of Bessel functions other than the above to make known this fact.

Communications should be addressed to the secretary of the committee, Dr. L. N. G. Filon, University College, Gower Street, W.C. M. J. M. HILL.

University College, Gower Street, W.C.

Baskets used in Repelling Demons.

IN the issue of NATURE published on May 27 Mr. Kumagusu Minakata inquires regarding the use of baskets in repelling demons in countries other than Japan. In Calcutta, and I believe in other parts of India, it is customary when a new building is being erected to set up on the highest part of the scaffolding a pole, to the top of which a round basket and a scavenger's broom are attached. The basket and broom are apparently recognised as emblems of the low-caste "sweeper," and therefore as being disgusting objects. They are supposed to ward off ill-luck from the building. Their use in this instance may thus be compared to the use in many countries of obscene objects or gestures as a protection against malicious spirits or the evil eye. N. ANNANDALE.

Indian Museum, Calcutta, June 13.

THE SINHALESE PEOPLE AND THEIR ART.

TO many it will appear that in this work Dr. Coomaraswamy has attempted too much; certainly the three purposes for which he tells us the book has been written have so little in common that a book which even in measure shall satisfy all three cannot be otherwise than loosely knit and somewhat amorphous. This volume, we are told, is written "first of all for the Sinhalese people as a memorial of a period which at present they are not willing to understand. . . . Secondly it is meant for those in East and West who are interested in the reorganisation of life, and especially of the arts and crafts under modern conditions. Thirdly, an endeavour has been made to render it as far as possible of value to the anthropologist, and to students of sociology and folklore." It seems very doubtful whether the Sinhalese people, with the possible exception of a few of the "educated" of whom Dr. Coomaraswamy speaks with scant sympathy, will appreciate the effort made for their benefit, and though there is much of interest to the folklorist and anthropologist in this sumptuous volume, it is as a work of art done for art's sake that the work is most interesting and valuable, and certainly few will be found to imitate Dr. Coomaraswamy's example at a time when publishers tell us *éditions de luxe* do not sell.

Not only the contents of the book preach the gospel of art, but, as it has been printed by hand on handmade paper, it is itself an excellent example of the point of view which, since this is a pioneer work, the author has been free to express with the least possible constraint. It is, indeed, in the fact that so much new ground is broken that the high merit of this volume lies, for it is certainly the first time that a detailed account of the arts and crafts of a small area in the East has been given, and it is well to remember that the culture here described was really limited to some two million people, inhabiting, roughly, two-thirds of an island, itself about the size of Ireland.

The arts and crafts of Ceylon, as they exist at the present day, represent the result of the action of western influence on the mediæval conditions which prevailed until the British occupation of Kandy, less than a century ago. It is with the remains of this late-lasting mediæval culture that Dr. Coomaraswamy mainly deals, and we are thus given an account of the work of the craftsmen of a feudal period in which there was no great attainment in fine art, brought about by the genius of a few men, but in which there was a widely spread popular art largely based upon early Indian traditions, for "Sinhalese art is essentially Indian, but possesses this special interest, that it is in many ways of an earlier character, and more truly Hindu—though Buddhist in intention—than any Indian art surviving on the mainland so late as the beginning of the nineteenth century. The minor arts and the painting are such as we might expect to have associated with the culture of Asoka's time, and the builders of Barahat. . . . It was the art of a poor people, the annual income of whose kings did not in the eighteenth century amount to 2000*l*. in money, besides revenue in kind."

FIG. 1.—Verandah Ceiling Painting, Dalada Maligawa, Kandy, 19th Century. Now destroyed. From "Mediæval Sinhalese Art."

The first chapter of Dr. Coomaraswamy's book is devoted to the Sinhalese people and their history. The next chapters discuss the social organisation of Sinhalese society, and while the difficult question of caste is but lightly touched upon, considerable space is devoted to the personal services rendered to the king and his high chiefs. This account shows how true was Knox's narrative, and it is pointed out that Sinhalese villages were self-contained to such a degree as to be dependent upon the outside world for little but salt. The religion of the people is rapidly sketched, and certainly too little stress is laid on the large element of demonism—"devil-worship"—in the actual working religion of the Sinhalese. A most interesting account is given of the *nētru mangalaya*, or "eye ceremony," by which the image in a temple is dedicated. This consists essentially in the painting of the eyes of the image, when the figure, before this, "not accounted a god but a lump of ordinary metal" (Knox), becomes so full of power that in some cases

[1] "Mediæval Sinhalese Art." By Ananda K. Coomaraswamy. Pp. xvi+340; 53 plates. (Broad Campden, Glos.; Essex House Press, Norman Chapel, 1908.) Price 3*l*. 3*s*. net.

anyone interfering with it is smitten with sickness. In this ceremony a mirror was held to receive the first glance (*belma*) of the image while the eyes were being painted.

An account of the teaching of drawing as practised at the present day serves as an introduction to a consideration of the *motifs* employed in Sinhalese decorative art. Although there is an immense amount of new material in this section, it may be doubted whether it would not have been rendered more valuable to all, as it certainly would have been to the anthropologist, if greater attention had been paid to the history of the evolution of the individual elements of decoration; for instance, the *makara*, which bulks so largely in Sinhalese art, and which occurs on the Barahat Stupa, *circa* 200 B.C., is dismissed in rather less than half a page of print, while the *hamsa* fares even worse. These and many other conventional elements were most skilfully combined, and the beauty of the results attained is seen in plate xvi. (here reproduced in Fig. 1), of a nineteenth-century ceiling painting from the Dalada Maligawa, Kandy, representing a forest scene.

FIG. 2.—Guardian Deity from a Temple Door Jamb, Ivory. Height of plaque, 10⅜ inches. Colombo Museum Collection. From "Mediæval Sinhalese Art."

There are chapters on architecture, woodwork, stonework, figure sculpture, and painting, the reduced colour plates of some of the wall paintings in Degaldoruwa Vihara, Kandy, being extraordinarily faithful reproductions of the originals, the spirit of which they have preserved to a surprising degree.

An interesting conjecture is made in chapter x., which suggests that ivory was comparatively little used in Indian art on account of the Hindu reluctance to use the products of dead animals; Buddhists had no scruples of this sort, and so ivory was always valued and used in Ceylon even in temples, with the result that ivory carvings are perhaps the most beautiful and pleasing fruit of the Sinhalese art impulse, rivalled only by some of the superb inlay metal work still existing on the temple doors. Fig. 2 represents an ivory carving in the Colombo Museum of a guardian deity from the jamb of a temple door.

In the last two chapters Dr. Coomaraswamy shows that, in the present stage of our knowledge, it is only possible to indicate the main sources which have influenced Sinhalese art. The most widely exerted influence in Indian art is that due to the Asokan Buddhist missions, the culture which these dispersed being early Indian; thus Sinhalese art is largely the result of the evolution of an early Indian art, in part sheltered by the geographical position of Ceylon from that Hinduism which overwhelmed it upon the mainland. But in post-Asokan and mediæval times this art was continually exposed to Indian influence; "indeed, until the close of the period of mediæval conditions, the relations between Southern India and Ceylon were similar to those obtaining in the Middle Ages between France and England." This leads to the suggestion that the famous rock paintings at Sigiri, the like of which are found only at Ajanta, are due to a school, representatives of which were to be found both in India and Ceylon. The fine bronzes recently found by Mr. H. C. P. Bell at Polonnarua and now in the Colombo Museum, though of a later date, point in the same direction, for the whole feeling of these is Hindu. To sum up, Dr. Coomaraswamy sees in Sinhalese art "an early stratum of indispensable barbaric decorative motives, . . . then a main stream of North Indian Buddhist influence; and thereafter the influence of continued reliance upon and intercourse with India, especially Southern India, accounting at every period for the strong admixture of purely Hindu with Buddhist *motifs*." With this conclusion few will quarrel, though Dr. Coomaraswamy says all too little concerning the earliest stratum. It remains only to direct attention to the number and excellence of the photographs by Mrs. Coomaraswamy, and to indicate that it is owing to her energy that the remains of the moribund art of Sinhalese embroidery have been brought together to form chapter xv.

C. G. S.

A DISCUSSION OF AUSTRALIAN METEOROLOGY.[1]

THE meteorology of the southern hemisphere presents a specially attractive field of study. The large area of water surface conduces to much simpler conditions than are to be found to the north of the Equator, and here, if anywhere, the meteorologist may hope to discover the fundamental principles underlying the general movements of the atmosphere. On the other hand, he has to face the relative paucity of data. The meteorological organisations of the three great land areas are still young, and our knowledge of what is happening over the sea is woefully small as compared with the completeness with which we are able to track down changes occurring over the great trade routes of the North Atlantic. The present discussion forms a recapitulation and a completion of work published from time to time from the Solar Physics Observatory, of which abstracts have appeared in previous numbers of NATURE (lxx., p. 177; lxxiv., p. 352). At the outset we congratulate Dr. Lockyer on his success in bringing together a vast amount of information and on the skill with which he has marshalled the facts deduced therefrom.

1 Solar Physics Committee. A Discussion of Australian Meteorology, by Dr. W. J. S. Lockyer, under the direction of Sir Norman Lockyer, K.C.B., F.R.S. Pp. vii+117; 10 plates. (London: Wyman and Sons, Ltd., 1909.)

The opening chapters deal exclusively with Australian conditions. Pressure observations are considered first. The mean amplitude of the difference between a number of conspicuous minima and the succeeding maxima in the curves showing the annual variation, amounts to more than seven-hundredths of an inch. When the curves for those stations for which long records are available are compared, they all show a marked similarity, and the important generalisation is arrived at that simultaneous excess or defect of pressure in any one year is a marked feature of the whole Australian continent, and is not restricted to any one particular portion of this area. Coming next to the rainfall observations, an examination of the curves leads to a similar conclusion. Years of low rainfall are, broadly speaking, years of deficiency over the whole continent, and in years of excess the excess is also general. Moreover, a comparison of the rainfall and pressure curves suggests very strongly that periods of high pressure are periods of low rainfall, and *vice versa*. These are generalisations of great importance, for they introduce a great simplification, and correspondingly facilitate the further study of Australian weather conditions. In view of the few data available in proportion to the area considered, a meteorologist, arguing from analogy, might be disposed to regard these as hasty generalisations. The extraordinary variability of rainfall in other parts of the world is well known, and for its adequate study a large mass of information is essential. When the necessary figures are forthcoming we find that even within the narrow limits of our own islands there are very conspicuous differences between the north of Scotland and the south of England. Australian conditions are, however, different. As Dr. Lockyer points out, the weather of the continent is dominated primarily by anticyclones travelling from west to east. In years of high pressure these anticyclones are found to embrace a wider area, and thus the low-pressure systems which skirt their edges and bring rain to the northern districts in summer, and to the southern ones in winter, affect the land area to a smaller extent.

In discussing these questions of correlation, whether it be between variations of the same element at different places or between different elements, Dr. Lockyer uses the similarity between two curves as his standard of measurement. The points of resemblance to which he directs attention are, indeed, striking. At the same time, the reader feels a desire for a more definite expression of the relation between the elements under comparison. When we come to the correlation between the Australian curves and those for other parts of the world, which takes up much of the later part of the work, this becomes more imperative. Thus, on p. 72, after discussing the striking resemblance between the pressure changes at Adelaide and those of Bombay or Batavia, we read, "While the Cordoba curve is nearly the inverse of Adelaide—the curve for the Cape seems to be intermediate, being more inclined to be similar to the Australian type of variation than that of South America." The intermediate between two curves which are inverse to one another should be a straight line. If it is meant that the Cape curve follows now the variations of Adelaide and now those of Cordoba, it becomes a matter of importance to have some means of comparing the degrees of similarity in the two cases. Superpose any two arbitrarily drawn curves showing fluctuations of approximately the same amplitude, and we are sure to find that some of the maxima and minima agree. Can we say by how much the correlation between the curves we are discussing exceeds that between curves drawn arbitrarily?

The question of periodicity naturally comes in for discussion. After eliminating a variation of short period by taking means of groups of four years, Dr. Lockyer claims that the smoothed curves for Australia show a periodicity of nineteen years. It is true that there are conspicuous maxima in 1868 and 1897, and minima separated by about the same number of years, but this does not of itself prove a recurring periodicity, and the case is not advanced by drawing a "hypothetical" curve through the points of maximum in which an intervening secondary maximum is disregarded and replaced by a principal minimum. The occurrence of a similar interval between the maxima in the pressure curve for South America, but of other epoch, is suggestive, but the question of the connection between the two continents remains one for further study.

A highly suggestive and interesting chapter on the air movements over the three great land areas of the southern hemisphere points out some interesting similarities between the pressure distribution and the incidence of rainfall of the three continents. The volume also contains an interesting comparison of the flow of the Murray river with the rainfall, and of the frequency of southerly "Bursters" with the variations of pressure. The work thus ranges over a wide field. It offers much that is new, and brings together from a common point of view much information that has hitherto been scattered in a number of individual papers.

R. G. K. L.

POSSIBILITY OF AN EXTRA-NEPTUNIAN PLANET.

M. GAILLOT has contributed an admirable note on this subject to the *Comptes rendus* (March 22). A summary of his calculations is set forth so clearly as to be easy to follow, and if we have one regret it is that he has not published the discordances between observed and tabular positions that necessarily form the basis of his work. We suppose that the *Comptes rendus* do not admit masses of tabular matter, and we wish to express the hope that M. Gaillot will publish this information somehow or other.

A review recently appeared in NATURE (June 17, p. 463) on Prof. W. H. Pickering's calculations. We there maintained that Prof. Pickering's supposed planet "O" could not possibly produce sensible perturbations in Uranus. Now, M. Gaillot and Prof. Pickering both locate their hypothetical planets in the same part of the sky. M. Gaillot's mass is five times that of the earth, or two and a half times that of Prof. Pickering's "O." A reader of the previous review will see that M. Gaillot's planet would, therefore, produce in Uranus inequalities exceeding a second of arc. We suspect that Prof. Pickering has made some numerical mistake in estimating the mass of his planet "O," and, if he can rectify this, we should then have two independent researches in practical agreement. M. Gaillot's result is, however, sufficiently confirmed by the analogy from inner planets developed in the previous review.

The important question now arises, "Are the observed discordances sufficiently large to point unmistakably to some unknown planet?" It is clear that an inequality with a coefficient of one second of arc appears to exist in the observations; but the elliptic constants of the orbit of Uranus are arbitrary, the observations are liable to small errors, and the theory of the action of known planets is not perfect. All this shows how unsafe it would be to assert the real existence of the inequality which would in its turn demonstrate the existence of an unknown planet. We may draw an analogy from the moon. The real existence of a term with coefficient nearly three seconds and period sixty-four years is now generally admitted in the motion of the moon. This term was first defined in 1904, and the case for its real existence was not a strong one until Prof. Newcomb arrived in 1909 at an almost identical conclusion from the totally different evidence of occultations. The term in the motion of Uranus must therefore be doubtful for the present. We are not entitled to do more at present than hope that it is real, and that a corresponding planet will reward M. Gaillot's admirable work. This doubt is fully admitted by M. Gaillot.

"Ces résultats ne doivent être acceptés d'ailleurs qu'avec une extrême réserve. En effet, les différences entre les positions observées d'Uranus et celles qui sont calculées a l'aide de nos Tables ne dépassent guère les limites des erreurs probables des observations augmentées de celles qui résultent des imperfections de la théorie. . . ."

It is noteworthy that, like Prof. Pickering, M. Gaillot bases his hypothetical planet upon Uranus and not upon Neptune. It appears, therefore, that the motion of Neptune is in good agreement with the tables, and that no extra-Neptunian planet can exist of a mass and epoch to produce sensible inequalities in the motion of Neptune since its discovery. This is an important negative result; in fact, if it be assumed that the unknown planet has a mass at least one-third that of Neptune, a considerable part of the ecliptic is excluded from the domain where this planet can possibly be found.

THE SORBY RESEARCH FELLOWSHIP.

IT will be remembered that the late Dr. H. C. Sorby, F.R.S., of Sheffield, bequeathed a sum of 15,000*l.* to the Royal Society of London to be held in trust for the establishment of a professorship or fellowship for original scientific research, the testator expressly desiring the professorship or fellowship thus founded to be associated with the University of Sheffield. Accepting this trust, the council of the Royal Society appointed a committee to confer with representatives of the University of Sheffield with the view of drawing up a scheme for giving effect to the intentions of Dr. Sorby's will.

A scheme, prepared by this committee for the establishment of a "Sorby Fellowship for Scientific Research" to be associated with the University of Sheffield, has now been approved and adopted by the council of the Royal Society, and by the senate and council of the University of Sheffield. This scheme provides for the administration of the income of the fund by a joint committee consisting of four persons appointed by the council of the Royal Society, one person appointed by the council of the University of Sheffield, and two by the senate of that University.

The object of the fellowship is not to train students for original research, but to obtain advances in natural knowledge by enabling men of proved ability to devote themselves to research; and in making an appointment the committee will pay special attention to the capacity for original work of a candidate, as shown by the work already done by him, and to the likelihood that he will continue to do valuable work. Each appointment will be in the first instance for five years, subject to the control of the committee, but may in special circumstances be prolonged for further periods if the committee is satisfied with the fellow's work.

The fellow will be required to carry out his research, when possible, in one of the laboratories of the University of Sheffield, and provision is made under the regulations for the setting aside of a sum not exceeding 50*l.* a year to form an apparatus fund, from which grants may be made from time to time to the fellow for the purchase of special apparatus and material required in his research. The stipend of the Sorby Research Fellow will probably be about 500*l.* per annum, and it is hoped that the committee will be in a position to make the first appointment to the fellowship early in the coming autumn.

PROF. T. W. BRIDGE, F.R.S.

WE regret to record the death, on June 30, of Dr. T. W. Bridge, Mason professor of zoology in the University of Birmingham. By his death the University is deprived of one of its oldest and most experienced teachers, and zoological science has lost one of those workers who, under the influence of Balfour and the Cambridge school, have contributed largely both by example and precept to our knowledge of vertebrate morphology.

Prof. Bridge was born in Birmingham in 1848, and after studying science at the Birmingham and Midland Institute, went in 1870 to Cambridge as assistant to Mr. J. W. Clark, then director of the Museum of Zoology. In 1872 he was elected to a foundation scholarship at Trinity College, and appointed demonstrator in zoology under the late Prof. Newton. After his graduation in 1875, he spent six months at Naples working in the zoological station, where, on the advice of F. M. Balfour, he carried out research into the "abdominal pores" of fishes. In 1879 he was appointed professor of zoology in the Royal College of Science at Dublin. In 1880 he became one of the original professors at the Mason College, Birmingham, holding the chair of biology; and when this chair was divided in 1882 he retained the title of Mason professor of zoology and comparative anatomy, and kept the same position when the Mason College became a University in 1900.

The original work carried out by Prof. Bridge dealt chiefly with the osteology of ganoid fish, the "pori-abdominales" of vertebrates, and the air-bladder of Teleosts. The most important of these memoirs are undoubtedly those dealing with the last subject, and the large paper by Profs. Bridge and Haddon, published in the Philosophical Transactions in 1893, on the air-bladder of Siluroids, has become a classic. This work was the first thorough investigation dealing with the structure and physiology of this organ which had appeared since Weber's original discovery and fundamental treatise on the air-bladder published in 1820. In certain Siluroids, Weber found that extraordinary apparatus which still bears his name. He described in a few families the vertebral elements that link the air-bladder with the ear, and concluded that the apparatus subserved the function of hearing in these fish. What was now required was a systematic inquiry into the variation of this mechanism and into the use or uses of it; and it is this monographic treatment that we owe to Prof. Bridge and his collaborator. They investigated 100 species of Siluroids, and concluded that this highly specialised mechanism was employed, not for audition, but for the registration of varying hydrostatic pressures. These memoirs not only advanced our knowledge of this interesting structure, but threw light on many points of ecological interest in connection with other physostomatous Teleosts.

Prof. Bridge's most recent work was his article on fishes in the "Cambridge Natural History" (1904). This article has proved one of the most useful treatises on this subject both to teachers and students. The value of his work was recognised by his election into the Royal Society in 1903.

We must not conclude this short article without bearing witness to the great success of Prof. Bridge as a teacher. He excelled, to no common degree, in grounding his pupils in the elements of zoology. As examination candidates his students showed unusual accuracy, and, in the main, a wide knowledge. Those of them who were able to go further and undertake some piece of research found in him not only a stimulus, but an unwearied guide and a sagacious critic.

NOTES.

M. G. DARBOUX has been re-elected president of the Société des Amis des Sciences, MM. Aucoc and Picard vice-presidents, and Prof. Joubin general secretary. The society was founded in 1857 by Baron Thenard with the view of assisting unfortunate inventors, men of science, and professors and their families. Among the names of past-presidents of the society occur those of Thenard, J. B. Dumas, Pasteur, and others. Since its foundation the society has distributed in pensions and grants more than two and a half million francs. This year eighty pensions have been granted to old savants or their widows. The society has assisted the education of some seventy children, and made grants to thirty-five widows. The work of the society should appeal to all who benefit from the work of men of science. Information as to the society may be obtained from the treasurer, M. Fouret, 79 boulevard Saint-Germain, Paris.

WE learn from *Science* that the people of Honolulu have guaranteed already half the money asked for by the Massachusetts Institute of Technology for the maintenance of an observatory which the institute proposes to establish at the brink of Kilauea for the study of volcanic action.

THE Geologists' Association is arranging a long excursion to the Arenigs, from July 28 to August 7, under the direction of Mr. W. G. Fearnsides. The excursion secretary is Mr. E. Montag, 4 Queen's Road, Rockferry, Birkenhead.

THE Vienna correspondent of the *Times* announces that during excavations near Willendorf on the Danube by the prehistoric section of the Austrian Natural History Museum, a chalk figurine, 11 centimetres high, representing a female figure, was discovered in a stratum containing instruments and weapons characteristic of the Stone age.

THE maps of the cadastral survey of Egypt have just been used to determine accurately the area of land planted with cotton and its distribution. Each plot in which cotton was sown was marked on the maps (scale 1/2500), so that not only the area and position were recorded, but, since the land-tax has been recently re-assessed with the aid of these maps, the distribution of cotton on land of different degrees of fertility was also determined. The total area was 1,466,530 feddans, or 1,522,258 acres.

THE Naples Academy of Sciences (mathematical and physical section) offers a prize of 1000 lire for the best essay containing a systematic exposition of our present knowledge of the geometrical configurations of the plane and of spaces, considered in relation to the theory of substitutions, with, if possible, some new results. The memoirs are to be sent in anonymously not later than June 30, 1910.

IN *Travel and Exploration* for July Mr. H. Massac Buist discusses what the nations are doing in the progress of aviation, and refers to the annual prize offered by him to the Aërial League for the best essay by a member of that body dealing with the attention that is being devoted by the leading civilised nations to the advancement of aërial locomotion. The first competition is to close on January 31, 1910. In his article the author shows that while Governments are mainly devoting their attention to the construction of dirigibles, aëroplane machines are, to a large extent, being developed by private enterprise.

WRITING in the *Oxford and Cambridge Review*, with a foreword by Lord Montagu of Beaulieu, Mr. R. P. Hearne advocates the introduction of aviation as a form of sport at the older universities. It is pointed out that such a scheme would produce a school of skilled aviators whose experience would be of great value in future developments of aërial navigation. While the possibility of an Oxford and Cambridge flying race is suggested, we would point out that, in view of the fact that the great majority of Varsity men cannot afford to spend 1000*l.* on a motor-driven machine, the man of moderate means might participate in the sport by gliding down a suitable incline selected on the Gogmagogs, Madingley Hill, or Royston Heath.

THE number of records of earthquakes obtained at Shide, Göttingen, Hamburg, and Laibach between January 1 and April 30 this year were, respectively, 98, 65, 61, and 33. Each of these earthquakes extended over wide areas, and was recorded at more than one station. At Shide the instrument employed is of the type adopted by the British Association. At the other stations the records were made on smoked paper or by photographic arrangements with a high multiplication.

THE annual general meeting of the Royal Society of Arts, the 155th since the foundation of the society in 1754, was held on Wednesday, June 30, Sir William H. White, K.C.B., chairman of the council, in the chair. The Prince of Wales was re-elected for the ninth time in succession president of the society, and the council, with certain additions and alterations, was re-elected. The principal business of the meeting was the reading of the annual report, which recorded the proceedings of the society during the past year. Reference was made to the failure of the renewed attempt made by the managers of the London Institution to amalgamate with the society. The number of the society's members is now 3490.

THE *Times* announces that in July of next year there will be held in Brussels, in connection with the International Exhibition of 1910, the first International Congress of Administrative Sciences, under the direct patronage of the Belgian Government. The term "administrative sciences" is defined by the congress committee as meaning the sum of theoretical knowledge relating to the services, the organisation, the machinery, and the action of Governments, and to the most practical methods to be employed by them. The honorary secretary to the British committee of the congress is Mr. G. Montagu Harris, Caxton House, Westminster, S.W.

THE recent notices issued by the committee of the International Aëronautical Exhibition at Frankfort show that many valuable prizes, in addition to those we have already mentioned, have been placed at its disposal, including one by the German Emperor; three prizes are also offered for the best kinematographic films of natural flight. A series of scientific lectures will be delivered, the first being on July 12, by Major v. Parseval, who will describe his air-ship and its potentialities; many other well-known men of science have also fixed the dates of their lectures. The physics of the upper air will be discussed by Profs. Assmann, Hergesell, Süring, and others. A list of the lectures and prizes already arranged is published in the first number of the exhibition journal *Ila*, this title being a contraction of Internationale Luftschiffahrt Ausstellung.

We are indebted to the author, Dr. K. J. Bush, for a copy of notes on the molluscan family Pyramidellidæ, published in the June number of the *American Journal of Science*. These notes may be regarded as in some degree supplemental to the article on the same group contributed by Mr. P. Bartsch to vol. xxxiv. of the Proceedings of the Boston Society of Natural History.

The crinoids of the family Comasteridæ undergo revision at the hands of Mr. A. H. Clark in No. 1685 of the Proceedings of the U.S. National Museum, no fewer than five new genera, of which three are based on new species, being named and described in the course of the paper. The communication relates, to a great extent, to material collected by the *Albatross*.

Polychætous annelids from Monterey Bay and San Diego, California, are discussed by Dr. J. P. Moore in the June issue of the Proceedings of the Academy of Natural Sciences of Philadelphia, the collections on which the paper is mainly based having been obtained from San Diego in 1902 and 1903, and from Monterey Bay in 1903 and 1904. The total number of species mentioned is sixty-four, of which twenty-one are believed to be new to science. Many other forms doubtless remain to be described, as at both localities collecting was almost entirely restricted to inter-tidal limits, although a few hauls were made with the dredge.

Darwinism looms large in the June number of *Neue Weltanschauung*, in which the opening article is devoted to a biography of Dr. August Weismann, accompanied by an excellent portrait of that distinguished biologist and evolutionist. There is also a notice of an interesting Darwin exhibition recently opened at Carlsruhe, and arranged by Prof. Walther May. The exhibits are divided into three sections, one historical and biographical, the second theoretical, and the third bibliographical. In the first are included a series of pictures illustrative of the life of Darwin and of the influence of the environment on the organism, while the second is devoted to pictures and specimens illustrative of Darwin's observations and teaching.

The fresh-water crustaceans of Algeria and Tunis form the subject of the first paper in the June number of the Journal of the Royal Microscopical Society, this communication being based on the collections made by the author, Mr. Robert Gurney, in February and March, 1906. Although the Algerian fresh-water crustaceans have been better worked out than those of any other part of Africa, the author finds that even here our knowledge is far from complete, while still more remains to be done in Tunis, especially in the Tell, or coast-district. A very large number of species were collected, of which several are described by the author as new, the ostracods being omitted and reserved for a future communication. Perhaps one of the most interesting of the forms discovered during the visit is the malacostracan *Cirolana foutis*, described by the author in the *Zool. Anzeiger* for 1908 on the evidence of three examples found under stones at the mouth of a spring near Biskra.

As the result of a biological survey of the Belgian coast undertaken by the Royal Museum of Natural History of Belgium, Mr. G. Gilson, the director of that establishment, has been enabled to describe a new and interesting parasite which in autumn frequents the nursing-chamber of the females of the schizopod crustacean *Gastrosaccus spinifer*. Seeing that the schizopod occurs in great swarms at some distance from the shore, it is a matter for surprise that the discovery of the infesting parasite should have been so long delayed, especially as the latter is of relatively large size. The parasite is itself a crustacean, referable to the group of epicarids, a section of isopods which have become degraded in accordance with the requirements of a parasitic existence. Although nearly related to Dajus, Mr. Gilson is of opinion that the new species should represent a genus by itself, and accordingly proposes the name *Prodajus ostendensis*. The paper, of which we have received a separate copy, is published in vol. xliii., pp. 19–92, of the *Bulletin scientifique de la France et de la Belgique*.

A copy of the Milroy lectures on disinfection and disinfectants, delivered by Prof. R. Tanner Hewlett, and reprinted from the *Lancet*, has been received. In these three lectures Prof. Hewlett decided not to deal with the details of the various methods of practical disinfection, for these are to be found sufficiently described in every text-book of hygiene; he has rather set himself to discuss the scientific principles embraced in the practice of disinfection. He first refers to the natural processes which reduce or destroy specific micro-organisms, such as dilution (by air, water, &c.), sunlight, desiccation, filtration (as in soil); he then turns to the defensive mechanisms with which nature has endowed the human body; and after making a brief reference to the application of internal disinfectants, he passes to a consideration of the disinfection of the infectious material outside the body. References are made to school disinfection, the requirements of an ideal disinfectant, the nature of the processes of disinfection, and the standardisation of disinfectants on the basis of their germicidal values. During the past few years much controversy has arisen upon the value of various methods of gauging the relative germicidal powers of disinfectants, and although advance has been made, we are still some distance from the goal of a satisfactory scientific method; it is important that this matter should be placed upon a sound basis, for, as Prof. Hewlett points out, the use of a disinfectant engenders a sense of security which, in the case of an inefficient one, is unreal, and may lead to disastrous results. The market is flooded with inefficient disinfectants, and there is at present no legal restraint upon their sale.

We have been favoured with the report of the director of the Royal Botanic Gardens, Ceylon, covering the reports of the various subordinate officers connected with the gardens. Dr. Willis refers very hopefully to the introduction of American machinery for tilling the ground, owing to the success attending the trial at the experiment station in the north of the island. The growth there of Ceara rubber has been excellent, and in consequence nurseries of *Manihot dicholoina* have been formed. The Government chemist, Mr. M. K. Bamber, gives some particulars of analyses of young and old cacao leaves. In the young leaves potash and phosphoric acid accumulate to the extent of 35 per cent. and 10 per cent. respectively, but very small quantities are present in old leaves, which contain a large amount of silica combined with lime and magnesia.

Mr. N. N. Woronichin, who has been studying the distribution of the algæ in the Black Sea, communicates a preliminary account to the botanical section (No. 7) of *Travaux de la Société impériale des Naturalistes de St. Pétersbourg* (vol. xxxvii., part iii.). Three vertical zones of distribution are distinguished. The littoral zone is narrow, as there is no appreciable ebb and flow; *Ralfsia verrucosa, Corallina virgata, Rivularia polyotis,* are the chief forms in certain bays, and in others species of Ulva and Enteromorpha are the most general. The second zone comprises depths from two to eight fathoms, where *Cystoseira barbata* is everywhere the dominant species. A third zone ranges from ten to thirty fathoms; *Polysiphonia elongata* is the chief formation down to twenty-five fathoms, then *Zanardinia collaris* is dominant, and lower *Antithamnion plumula.*

A SERIES of short papers by Dr. J. N. Rose relating to xerophytic plants of the unrelated but morphologically similar families of the Crassulaceæ and Cactaceæ is collected in vol. xii., part ix., of Contributions from the United States National Herbarium. A Mexican plant, formerly described from barren specimens as an Echeveria, is made the type of a new genus, Thompsonella. Another plant from Vera Cruz restores the species *Echeveria carnicolor.* Three new species of the same genus are recorded from Guatemala. The re-discovery of the Cuban species of tree cactus, *Cereus nudiflorus,* is interesting; other new species are an arboreal Pereskia, a remarkably spiny Echinocereus, and a Nopalea. Dr. Rose also describes a leguminous tree resembling a Cercidium, but sufficiently distinct to be placed in a new genus, Conzattia. The photographs illustrating the habit of these plants are admirable.

THE scenery of the Greater Antilles forms the subject of an interesting paper read by Sir H. H. Johnston at the Royal Geographical Society, and published in the June number of the *Geographical Journal.* The subject provides ample scope for the author's well-known powers of observation and description. Reference is made to the striking character of the royal palms, *Oreodoxa regia,* in Cuba, an avenue of which "looks like a column of white marble pillars crowned with a gerbe of glossy green fronds." The palmetto, *Sabal palmetto,* and two other palms with fan-shaped leaves, Thrinax and Coccothrinax, are prominent in the landscape of the plains and foothills. Tall cacti contribute largely to the scenery of eastern Cuba, especially on sandy flats. In the island of Haiti the agaves aroused the author's admiration. With regard to Jamaica, the author presents a sketch of the vegetation in January; he also offers a word of advice in the matter of retaining such natural beauty spots as Fern Gully.

WE have received revised editions of two useful little manuals:—(1) "Observing and Forecasting the Weather," by Mr. D. W. Horner; and (2) "Some Facts about the Weather," by Mr. W. Marriott. The first is intended for those who may wish to obtain some knowledge of the weather without the use of instruments. For such persons the work contains much useful information; the chapters on clouds and optical phenomena, from which successful forecasts may often be drawn, are especially interesting, as are also the sections on old weather proverbs and the popular fallacy of the moon's influence. The work is accompanied by some good typical illustrations. The second pamphlet gives "some of the results which have been obtained from present-day systematic meteorological observations in the British Isles," and is of special interest to those possessing instruments for an ordinary climatological station. It contains useful information referring to each of the meteorological elements, the use of synoptic charts, and particulars of average and extreme values; it also deals with special subjects, *e.g.* electrical phenomena and the investigation of the upper air, and contains many useful illustrations. The work will be acceptable to many who may wish to obtain accurate general weather knowledge without reference to more pretentious instructions and text-books.

THE *Electrical Review* for June 18 contains a list of the electric tramways, railways, and power companies of the United Kingdom. We note that the following towns head the list of those having electric tramways:—Manchester 105, Glasgow 95, London 86, Liverpool 59, Bradford 55, and Leeds 54 miles of track. The leading electric railways are:—the Liverpool and Southport with 35, the Newcastle and Tyneside with 30, the Metropolitan with 26, and the Metropolitan District with 24 miles of double track. The greatest power companies are:—the Newcastle-on-Tyne with a station capacity of 47,000 kilowatts, and the Durham Collieries with 11,000 kilowatts. One of the points which a study of the list brings out is the great popularity of electric traction in the northern towns as compared with the indifference in the south.

BY means of quotations from the "Atomistic" of 1862 and the "Weltleben" of 1881 of Robert Grassmann, Dr. F. Kuntze shows in the *Physikalische Zeitschrift* for June 15 that more than forty years ago the brothers Hermann and Robert Grassmann had worked out the details of an electronic theory to which the electronic theories of the present day bear some resemblance. According to the Grassmann theory, the smallest æther particle consists of a pair of entities to which symbols +E and −E are assigned. The pairs repel each other according to the inverse fourth-power law. When glass is rubbed with silk the +E is attracted to the glass, the −E to the silk, and the two bodies become electrified. Light is due to the oscillations of the pairs as pairs, electricity to the oscillation of the constituents of each pair. Heat is the oscillation of matter and the æther pair together. Matter in the same way consists of pairs of elements, and chemical combination of two substances is the attraction of the positive matter element by the negative part of the æther pair, and the negative matter element by the positive part of the æther pair. The positive and negative parts of a pair are supposed to keep apart owing to the motion of each round the other, as in a binary star.

AN interesting article on the mechanical testing of cast iron appears in the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for May. The author, M. Ch. Frémont, deals first with the historical aspect of his subject, giving drawings of early apparatus, and then proceeds to describe special machines of his own with which he has made many tests on small specimens for the determination of the coefficient of elasticity, the elastic limit, and the breaking strength. The results and plotted diagrams are given, and from these the author arrives at the following conclusions:—the testing under static bending of cast-iron samples of greatly differing strengths shows that the coefficient of elasticity varies considerably, from simple to triple proportion; the capacity for elastic bending of cast iron is inversely proportional to its strength; the elastic limit under static bending varies very greatly, being from 0·45 to 0·80 of the breaking strength.

MOST of the engineering and shipbuilding periodicals for the week ending June 26 contain reference to the new rules which are on the point of being issued by Lloyd's Register of British and Foreign Shipping. The revised rules are framed to include vessels up to about 680 feet in length, and they cover all the vessels previously classed by the society excepting the large Cunard steamers *Lusitania* and *Mauretania*. The most important modification in the new rules is in the basis for determining the "transverse number" and the "longitudinal number." The former number is now to be found by adding the breadth and depth only, and the latter by multiplying the length by the sum of the breadth and depth. It is also of importance to notice that all the sections in the tables conform to the standards of the Engineering Standards Committee. This is a very wise move, and is much to be commended. Another step in the right direction has been taken in the adoption of a unit for scantlings of one-fiftieth of an inch instead of one-twentieth as in the old rules. This not only conforms with the decimal system, but, as 0·02 inch is practically half a millimetre, a close connection with the metrical system is secured. As Lloyd's Register covers between 70 per cent. and 80 per cent. of the world's shipping for insurance purposes, the new rules cannot fail to influence the shipbuilding and steel industries in this and most foreign countries.

A NOTE in the *Bulletin de l'Institut Pasteur* for May 30 (vii., No. 10, p. 453) announces the discovery by Carlos Chagas, of Rio de Janeiro, of a new human trypanosome parasite (*T. cruzi*), conveyed by a bug (Conorrhinus), and causing an often fatal illness among miners and others in the State of Minas.

THE Bulletin of the Johns Hopkins Hospital for June (xx., No. 219) contains an interesting historical essay, by Dr. Gerster, on the life and times of Gerhardt van Swieten, physician to the Empress Maria Theresa, who was born in Leyden in 1700 and died in 1772 at Schönbrunn.

A COMPREHENSIVE note on the cartography of the Philippine Islands is given by Prof. Guido Cora in *Bollettino della Soc. Geogr. Ital.* as a notice of the recent map of the islands compiled from original sources by Mr. C. W. Hodgson.

WE have received from the Nottingham Free Public Library a copy of a simply arranged supplementary science catalogue of the central lending library dealing with books in most branches of science published between 1901 and the present year.

MR. R. B. HENDERSON, assistant master at Rugby School, has written an introduction to the study of moths and butterflies for the Rugby School Natural History Society, entitled "The Scaly-winged." It will be published immediately by Messrs. Christophers.

WE have received vol. vi. of "Contributions from the Jefferson Physical Laboratory." It consists of a reprint of twelve papers which have appeared in the Proceedings of the American Academy of Science or in other periodicals during the past twelve months. Five of these papers have already been noticed in these columns.

IN the announcement in NATURE of May 27 (p. 375) of the resignation by Mr. H. H. Clayton of his position at the Blue Hill Meteorological Observatory, it was stated that he had been in charge of the observatory since 1894. This statement does not express the position exactly. Mr. Clayton has served for many years as observer or meteorologist, and his researches have added to the reputation of the observatory, but the director is Prof. Lawrence Rotch, who founded the observatory in 1885, and provides for its material support.

THE June number of the *Stonyhurst Magazine* contains an illustrated description of the Milne seismograph used in the National Antarctic Expedition in H.M.S. *Discovery* under Captain R. F. Scott, R.N., in 1904. The seismograph is now a permanent loan to the observatory at Stonyhurst from the Antarctic committee of the Royal Geographical Society. The instrument stands at Stonyhurst on a solid stone pillar fixed in 12 inches of concrete; its position is lat. 53° 50′ 40″ N. and long. 9m. 52·68s. W. of Greenwich. A new recording apparatus has been secured, and there is every reason to hope that useful observations will be made at the new station.

OUR ASTRONOMICAL COLUMN.

COMET 1909*a*, BORRELLY-DANIEL.—Further observations of comet 1909*a* have revealed no striking features either in its form or in its behaviour. In No. 4334 of the *Astronomische Nachrichten* M. Chofardet records the observations made at the Besançon Observatory, and states that on June 17 and 19 the comet was of magnitude 11·0 or 12·0, had a round, diffused head of 1·5′ diameter, and a vague condensation which could be seen occasionally by oblique vision.

A NEW FORM OF COMPARISON PRISM.—In all spectroscopic work where a comparison prism placed over the slit is used, the dark band between the compared spectra, produced by the edge of the prism, constitutes an inconvenience which may prove a source of error. To remedy this defect, Prof. Louis Bell has employed a specially designed compound prism, in which the light from one of the sources is reflected from the fine edge of a thin layer of silver, whilst that from the other source is allowed just to miss the edge. Thus the line of demarcation is practically eliminated. The method of preparing such compound prisms is described, and illustrated by diagrams, in No. 4, vol. xxix., of the *Astrophysical Journal* (p. 305).

HALLEY'S COMET.—No. 4330 of the *Astronomische Nachrichten* contains two search-ephemerides for Halley's comet. The first is by Dr. Holetschek, who discusses the probable date of perihelion and gives three ephemerides, one for May 16·45, 1910, and the others for thirty days before and after respectively. At the previous apparition, in 1835, the comet was discovered 102 days before the perihelion passage, when its distances from the sun and earth were 1·9 and 2·4 astronomical units respectively; the corresponding distance from the sun will occur, according to Dr. Holetschek's data (T = May 16·45, 1910), on February 3, 1910. The second ephemeris has been computed by Herr L. Matkiewitsch from the data given in the essay which won the Astronomische Gesellschaft prize; the positions now given vary considerably, at different epochs, from those previously referred to in these columns (NATURE, No. 2046, January 14, p. 320).

THE POLARISATION OF THE SOLAR CORONA.—In the June number of the *Bulletin de la Société astronomique de France* M. Salet discusses at length the photographs obtained at the 1905 eclipse with a polariscopic camera. These photographs show the coronal radiations to be strongly polarised right down to the moon's edge, thereby indicating that reflected light is being dealt with; but the spectroscopic observations indicate that radiations directly from a light-source are in question. M. Salet suggests that the apparent contradiction may be explained by the theory that the bright radiations observed spectroscopically are due to metallic vapours rendered fluorescent by the intense solar radiation. In this condition metallic vapours give band spectra, and the superposition of these might, if small dispersion were employed, produce the appearance of a continuous spectrum such as has been observed. In support of his theory M. Salet quotes the observation of Sir Norman Lockyer at the eclipse of 1882, that the coronal spectrum appeared to be formed of superposed bands, and directs attention to the discovery of magnetic fields by Prof. Hale, which, with a rotating sun, afford the conditions necessary for his theory.

THE SOLAR CONSTANT AND THE APPARENT TEMPERATURE OF THE SUN.—In a note published in No. 7, vol. lxix., of the Monthly Notices (p. 611), Dr. Féry discusses the measurement of the solar constant and of the sun's mean temperature. One of the greatest difficulties in these researches is to evaluate the atmospheric absorption, which in published researches has varied from 1·5 to 4; it is generally accepted now as having the value 2·4.

Having designed an instrument for measuring terrestrial high temperatures, MM. Féry and Millochau applied it to the determination of the solar temperature by Stefan's law. More than 750 observations were made at different altitudes, and at the summit of Mont Blanc the zenith transmission was found to be 0·91; with this correction the temperature at the centre of the sun's disc was found to be 5550° absolute, and the mean temperature 5360° C. Before dispatching it to India, this instrument was re-standardised at the National Physical Laboratory, and, on a clear, dry day, gave eight concordant readings, from which the temperature at the centre of the disc was found to be 5153° absolute; on this day the zenith transmission at Teddington was, therefore, 0·74, or the absorption was 26 per cent.

Employing the accepted value of the constant (2·4), the recent researches give 5920° as the mean temperature of the sun; but Dr. Féry thinks this is too high, and, therefrom, deduces that the accepted value of the solar constant is too high. The Mont Blanc measures would indicate 1·65 as the value.

THE NATIONAL CONSUMPTION OF WATER.

AN important paper on the increase in the national consumption of water was read by Mr. W. R. B. Wiseman before the Royal Statistical Society on April 27. The paper is of considerable interest, and must have entailed a large amount of time and thought on the part of the author. The historical part, which deals with the early history of water supply in England, treats the question, not only from the general point of view, but gives many interesting details of the early methods adopted and the difficulties met with in many individual towns; in fact, it is not too much to say that the early beginnings of the water supply of all the principal towns in England are reviewed shortly in the paper. It is obvious that, as the object of the paper is to deal with the more modern questions which arise in connection with this subject, the author could not devote very much space to historical details. We can, however, judge that on this subject he has only touched the fringe of the information he has acquired, and it may perhaps not be too much to hope that he may return to this part of his subject at a future date.

The life of Sir Hugh Myddelton and the description of the work carried out by him of bringing the water from the springs of Chadwell and Amwell, in Hertfordshire, by means of the New River, for the supply of London are well known to most of us, and possibly the author of this paper may have material for the making of a story as interesting and romantic in connection with other towns.

The author says he was "tempted" to investigate the estimates of the population in the pre-censal period in order to determine whether the great increases in the population in the nineteenth century were abnormal or otherwise, as upon the answer to the query one must be guided in the provision of water supplies for future populations. As was to be expected, he found such an inquiry not of great value. He has, however, put together some interesting information as regards the growth of many towns, and has dealt with the reasons for the very rapid growth of several of them. From a general review, the conclusion arrived at is that "the nineteenth century was in no wise abnormal, and that a steady increase in the already considerable population may be expected throughout the twentieth century."

The author describes at some length the methods adopted for checking the waste of water in early days, and particularly the system adopted in Liverpool in 1868 of localising the waste by metering the supply in various districts.

Of course, the supply of water per head of population is the important question when dealing with the amount of water required, and the tables given of the supplies in a large number of towns show the variations which exist, and which extend from about sixty gallons as a maximum to below ten gallons as a minimum, leaving out one special case with small population which runs up to 124 gallons per head. The numbers all relate to total supply, which includes domestic, trade, and municipal demands. The statistics given show much greater uniformity of supply in the different towns than would have been anticipated, and it is evident from them that waste of water is carefully looked after in England, and all possible precautions taken to avoid it. If the consumption is compared with what is common in many of the large towns in the United States, where the water supply goes up to 200 gallons and more per head, it will be evident that the precautions taken in England have given very satisfactory results. The opposition to the use of water meters in the United States is probably the reason why leakage and waste continue on a large scale. This opposition is principally due to the view that, on sanitary grounds, it is not well to restrict the supply of water, but, as Mr. F. P. Stearns stated in his presidential address to the American Society of Civil Engineers, "no one has yet demonstrated the sanitary advantages of a leaky faucet or a defective ball-cock."

Table No. 5 is a valuable one. It gives, first, the population of more than 120 cities, towns, or districts in England for two or three years, with intervals, sometimes large and sometimes small, between the years. It then gives the total supply in each of these water areas during the years mentioned, dividing it up under the heads of domestic, trade, and municipal, the daily supply per head of population then following under the same heads.

Considerable space is devoted to the reasons which have caused an increase in the supply of water per head for domestic, trade, and municipal purposes. As regards domestic, it is, of course, well known that the displacement of old methods of sewage disposal by the introduction of the water-carriage system was the first cause of the great increase of the water supply. The increased and increasing use of fixed baths must also largely augment the consumption, as the water used for a bath by one person may vary from thirty to one hundred gallons. The author gives various other reasons for the increase in the domestic supply. As regards municipal supply, attention is directed to the increase in consumption due to the public baths, wash-houses, street conveniences, &c. The author states that he has endeavoured for some time past to collect data which will give some idea of the relative proportion of the water supply needed for particular works or industries, but the results have been too meagre to justify definite conclusions. He, however, deals in a general way with the amount of water used in a large number of industries, among which are breweries, distilleries, paper works, textile industries, and many others, and the information given is of an interesting character. The conclusion is that, on the whole, the rate of increase of water supply is greater in recent times than in those more remote. There probably would have been no doubt about this conclusion in anyone's mind, but, although this may be the case, it does not detract from the value of the information which has been collected in this paper to prove it.

The moral drawn is that, with the increasing amount of water required, there will be an increasing competition for the remaining first-class upland reservoir sites, which will become fewer and fewer as time goes on, and it is therefore desirable that steps should be taken at an early date to create some central authority "which should be charged with the duty of water conservancy in its widest application, and for that purpose should engage in a close and exact study of the water resources of the country." The author then goes more fully into the details which ought to be dealt with by such a body.

This proposal is, of course, not new, although of great importance. It was dealt with by Mr. E. P. Hill in a paper which he read at the Institution of Civil Engineers on November 27, 1906. In the beginning of that paper he said, "the water supply of the country is really a national matter, and it should be considered as a whole, and a town should not be allowed to appropriate a particular area unless it can be shown that in a general survey of available sources of supply that area can economically, from a water point of view, be allotted to it."

The value of the paper would have been increased if some information had been given as regards what is being done in other countries in connection with systematic investigation of water resources. There is no doubt that such an investigation is of more value and of greater necessity to the United Kingdom, where the population per acre is large, than to some of those countries which are at present rather sparsely inhabited, but which, at the same time, spend money on proposals such as have been suggested. In the United States this work was undertaken as a national one some years ago, a beginning having been made in 1894–5 by a grant of 12,500 dollars. This amount was gradually increased, until the grant in 1905–6 was 200,000 dollars. Since then there has, we believe, been some variation in the amount voted for this purpose.

Considering the large amount of work which the author must have gone through to prepare this paper, it may seem almost ungracious to suggest that he should add anything further to it as regards other countries, but he has shown such a large capacity for putting information together that we hope he may be tempted to even further research in connection with this subject.

MAURICE FITZMAURICE.

THE WAR AGAINST TUBERCULOSIS.

THE National Association for the Prevention of Consumption and other Forms of Tuberculosis was well advised to open its exhibition or collection of object-lessons in the Borough of Stepney. It may safely be said that the Whitechapel Art Gallery never had any company of more interested sightseers than the thousands who, at this exhibition a few weeks ago, examined and discussed death-rates, ventilation, graduated labour and the apparatus used in performing it in the treatment of consumption, apparatus for the treatment of tuberculous diseases, playgrounds, pathological specimens, back-to-back houses, overcrowding, food-stuffs and the principles of nutrition, methods of disinfection, and the like.

Any interested onlooker would have seen at once that the official conferences and set discussions constituted, after all, but a small fraction of the educational work that was being carried on. Here was an exhibition of which the main object was not to direct the attention of the public to any patent medicine or "all curing" nostrum, but how to regulate their daily life, how to avoid disease, and how to get the best food value out of their weekly wages, be these great or small. Nevertheless, the promoters of this exhibition, realising what an opportunity they had, also gathered together a number of medical and municipal delegates interested in the matter, to discuss the best means of preventing and curing tuberculosis.

Even those dropping in casually found an enthusiastic band of demonstrators, nurses from dispensaries and hospitals, attendants from graduated labour homes, from sanatoria and similar institutions, all hard at work explaining to small groups of interested men and women the meaning of the exhibits of which they were in charge. It was interesting to see the keenness with which both teacher and listener tackled the subject; and that these demonstrators were doing their work well was apparent from the numerous and intelligent questions that were put at the end of the demonstrations. Even to the sharp, snrewd Londoner the importance of ventilation, of cleanliness, of light, of suitable feeding, have been small, but a few exhibitions and demonstrations such as those seen and heard in Whitechapel Art Gallery will soon change all that; and the President of the Local Government Board has done nothing better for some time than in giving his countenance and support to what promises to be a really living movement.

What is the object and what are the lessons insisted upon at these conferences? Anyone visiting the exhibition would have it brought home to him in some way or other that between 1858 and 1907 there nad been a fall in the annual death-rate due to tuberculosis from 2700 per 1,000,000 living to 1150 per 1,000,000 living. He would also see that, were the fall to continue at the same rate, tuberculosis would be an extinct disease early in the 1940 decade. Although this is too favourable a state of things to look forward to, as there will always remain a certain substratum of tuberculous patients and foci that it will be almost impossible to reach, tuberculosis should undoubtedly be an almost negligible quantity in our death-rate by that time.

How has this fall been brought about? In the first place, even before Koch was able to prove the presence of the infective agent, the tubercle bacillus, in tuberculous lesions, it was realised by those who were studying the disease most closely that it could be transmitted from one person to another, and that crowded and badly ventilated rooms were, therefore, fruitful centres of infection. This was a very great step forward, the full effect of which, however, was not felt until Koch gave his wonderful demonstration of the presence of the tubercle bacilli. He isolated the infective agent—this tubercle bacillus; its life-history was studied, and its relation to the tissues of the animal body during the course of the development of the disease, demonstrated. In the history of the treatment of any infective disease little progress has been made in fighting against it until the causal agent has been demonstrated. Once this stage has been reached, however, the fight waged against infective disease of all kinds has become more and more effective. In the case of tuberculosis, the attack can now be delivered along many parallels. Every patient is looked upon as a possible centre of infection, and before setting about the cure of the patient those dealing with the case have set themselves the task of attacking the bacillus from every quarter and at every point. It is realised that the first thing to be done is to secure it, or kill it, if possible, immediately it leaves the patient, especially, of course, in the sputum, as it comes from the lungs.

In the case of tuberculosis, isolation, in the ordinary sense of the term, is out of the question, but although the patient cannot be segregated from his fellows—and in many cases it would be both unwise and cruel so to do—he should be carefully trained to isolate himself, so far as the tubercle bacillus is concerned, by taking every precaution to prevent any undisinfected material from getting beyond his immediate vicinity. More is necessary, however, than the mere killing of the bacillus as it leaves the human body; some attempt must be made so to build up the strength of the patient that his tissues may be capable of carrying on war with the bacillus either on fairly level terms or on terms in favour of the patient. This can only be done by ensuring good hygienic conditions—plenty of fresh air, light, good food, work enough with plenty of rest. Given these conditions, and the tubercle bacillus has a bad time of it; remove the conditions, and the bad time falls to the patient. It has been stated above that it is often unnecessary to segregate consumptive patients; it must be remembered, however, that in the late stages of the disease, when the patient is weak and when the various discharges from the body, sputum and other excreta, may contain enormous numbers of the infective bacilli, it may be advisable, and even necessary, in the patient's own interests as well as of those who daily come in contact with him, to keep him in hospital, to make his last days, or even weeks or months, as easy and as pleasant as possible for him. Moreover, under these conditions the destruction of the enormous number of tubercle bacilli coming from the body is a comparatively easy matter.

Those interested in the treatment of tuberculosis have for long been convinced that good feeding and fresh air are factors of prime importance in such treatment. Up to a few years ago, however, the results obtained, though very much better than any obtained under the old methods of treatment, were in certain respects extremely disappointing. The patients were not properly classified for treatment, and many died who apparently ought to have lived. Those who went to Whitechapel to learn would find that the treatment of consumptives under Dr. Paterson at

Frimley is a very different thing from the treatment carried on in the early days of sanatoria. Patients are no longer stuffed and rested indiscriminately. They are given work, rest, and food on a carefully graduated system; they are taught how to treat themselves—what to do and what to avoid. The sanatorium treatment, however, deals with but a small proportion of the cases; tuberculosis must be tackled on a much more extensive scale. Calmette in Lille and Philip in Edinburgh, seeing the importance of bringing the treatment of tuberculosis to the working classes and even the very poor, have organised what is now known as the dispensary system, in which are combined an intelligence department, an ambulance service, a training school, an out-patient and in-patient hospital service, and a sanatorium department. In Edinburgh the result has been a fall in the death-rate beyond that of other cities equally or more favourably situated, except in that they have not been provided with this well-organised system.

It is recognised that prevention of tuberculosis is certainly more important than its cure, and all interested in this question must realise what enormous impetus has been given to the whole movement by the energetic action taken by the President of the Local Government Board. His keen interest in the Milk Bill, in the Washington Congress on Tuberculosis, and in the Whitechapel Exhibition, his grasp of principles and the wealth of detail contained in his opening address at that exhibition, gave evidence of complete conviction and determination to act up to his conviction. All this marks a great advance in the public treatment of the question in this country. Medical men have long suspected that tuberculous milk was a prolific cause of abdominal consumption amongst their little patients. They have known how readily delicate children recovering from measles, whooping cough, inflammation of the lungs, and similar conditions, have been infected, sometimes from tuberculous patients, at other times, however, under conditions where infection from the human subject appeared to be impossible, and they now welcome with enthusiasm any legislation that will render impossible the spread of tuberculosis by the milk from infected cattle. Medical officers of health, aware of the insanitary conditions under which a large proportion of the population, not only urban, but rural, live, hail with satisfaction the idea that in any well-considered action they may take they will now, not only be commended, but helped. The National Association for the Prevention of Consumption has done well, not only to follow Ireland and America, but to improve upon the methods adopted in those two countries. Nothing but good can be the outcome of this movement, and we hope that the seventy thousand visitors to the Whitechapel Art Gallery will be followed by hundreds of thousands, who will have the opportunity of seeing this or a similar exhibition at the "White City" or on its tour through the large and populous centres of England, and perhaps even of Scotland.

VISION IN RELATION TO HEREDITY AND ENVIRONMENT.[1]

THE Francis Galton Eugenics Laboratory at University College, London, has already done much valuable work in many directions under the supervision of Prof. Karl Pearson. With the assistance of Miss Barrington, a useful inquiry has been made into the question of the inheritance of vision and the relative influence of heredity and environment on sight. The paper is a mathematical investigation of statistics culled from a variety of sources. Of these, two communications by Dr. Adolf Steiger, of Zürich, on the corneal curvature, and the report on 1400 school children issued by the Edinburgh Charity Organisation Society, afford the best material. Other contributory material of less value is taken from reports on the refraction of London elementary-school children by Dr. A. Hugh Thompson and the Education Committee of the London County Council, and on the eyesight of 500 Glasgow school children by Dr. Rowan. Throughout, the difficulty which specially besets such statistical investigations is present in the fact that all the material is intensely selected. There is no means of supplementing it by a knowledge of the distribution of astigmatism and other errors of refraction in the community at large. Thus, in dealing with percentage statistics of the heredity factor in myopia, the authors say that "the distribution of parents of the normal and the proportion of myopes to the normal in the general population (or at any rate in the 'universe under discussion') must be found before any appreciation of the effect of heredity can be made."

The first moot point which arises in dealing with the inheritance of refraction concerns the determination of the unit to be used to obtain a quantitative scale. It is now customary to measure the refraction in terms of the refractive power of the correcting lens instead of, as formerly, in terms of its focal distance. When the variations of the mean values in the population are small compared with the mean value in the individuals under discussion, it matters little which unit is adopted. This is true of corneal refraction (3 per cent.), but untrue of corneal astigmatism (75 per cent.). The difficulty is overcome by using, whenever possible, the method of contingency, fundamentally, or for purposes of control.

Investigation of the inheritance of corneal astigmatism leads to the conclusion that it is certainly inherited, as evidenced by minimum limits of 0·3 to the parental and of 0·4 to the fraternal coefficients, but the material is neither sufficient nor sufficiently classified to determine with any degree of certainty the accurate value of the inheritance coefficients. The authors point out that "there is a splendid field for a man who will measure the corneal astigmatism in a non-selected population." As this would be an easy and accurate task with the ophthalmometer there ought to be no difficulty in getting it carried out. Investigation of corneal refraction shows that it is inherited at the same rate as other physical characters in man. In dealing with the inter-relations of refraction, keenness of vision, and age, the results show how much more influence myopia has on visual acuity than hypermetropia, and that refraction defects contribute more than half the abnormality of keenness of vision. They further show that there is not the least doubt of a sensible relationship of age to each of the several categories of eye defect. It is probable that a great deal of hypermetropia, hypermetropic and mixed astigmatism disappears, probably owing to growth, between six and ten, thus swelling the number of emmetropic eyes, but that after this age there is not sufficient evidence to say whether these categories vary or not. Myopia and myopic astigmatism increase throughout, but this increase does not balance the total gain due to rectification by growth; it may be caused by continued action of some environmental factor, or by a growth factor.

The general conclusions derived from the slender data of this first study are as follows:—There is no evidence whatever that overcrowded, poverty-stricken homes, or physically ill-conditioned or immoral parentages are *markedly* detrimental to the children's eyesight. There is no sufficient evidence that school environment has a deleterious effect on the eyesight of children. Though changes of vision occur during school years, they are phases of one law of growth, a passage from hypermetropia to emmetropia and myopia of the eyes of "unstable stocks." There is ample evidence that refraction and keenness of vision are inherited characters, and that the degree of correlation between the eyesight of pairs of relatives is of a wholly different order to the correlation of eyesight with home environment. Intelligence as judged by the teacher is correlated with vision in only a moderate manner (p. 16). We scarcely think that the data justify so strongly worded an *ex cathedra* statement as that made by the authors in conclusion:—"The first thing is good stock, and the second thing is good stock, and the third thing is good stock, and when you have paid attention to these three things fit environment will keep your material in good condition. No environmental or educational grindstone is of service unless the tool to be ground is of genuine steel—of tough race and tempered stock."

[1] University of London. Francis Galton Laboratory for National Eugenics. Eugenics Laboratory Memoirs. V. A First Study of the Inheritance of Vision and of the Relative Influence of Heredity and Environment on Sight. By Amy Barrington and Karl Pearson, F.R.S. Pp. 61. (London: Dulau and Co., 1909.) Price 4s.

CHILD EMPLOYMENT AND EVENING CONTINUATION SCHOOLS.

ANOTHER appendix volume, No. 20, to the report of the Royal Commission on the Poor Laws and Relief of Distress has been published (Cd. 4632), and incidentally indicates the directions which educational effort should take in this country in order to ensure the provision in future years of better educated workmen in the various industries on which the success of this country depends.

The report is by Mr. Cyril Jackson, chairman of the Education Committee of the London County Council, who acted for the commission as a special investigator to inquire and report on the main occupations followed by boys on leaving public elementary schools in certain typical towns; the opportunities of promotion in such occupations or of training for other occupations; and the extent to which such boys subsequently obtain regular employment (skilled or unskilled) as adults. Mr. Jackson was given power to make any feasible suggestions of a remedial character indicated by the facts, and he limited his investigations to a consideration of the prospects of permanence and educative value for adult industry of the occupations entered upon by the boys with whom he was concerned.

As regards the methods of inquiry adopted, it may be said that Mr. Jackson was able, from the sources of statistical information he found available, to obtain an idea of the various occupations in which there was an apparent excess of boys who could not when adults be absorbed in the same branch of industry. He afterwards, by interviews and by the distribution among employers of special forms to be filled up, obtained some further information as to these occupations; but he met with many difficulties, and only a small proportion of the forms were returned to him. In addition, a form of industrial biography for young men was issued to obtain direct evidence of the length of time boys remain in particular occupations and the age at which they were displaced if they have been in boys' work which does not lead to permanent employment as adults; but a third only of the forms circulated were filled up and returned—" Lads are always suspicious of anything which they think is prying into their affairs, and they believe there must be 'something behind,'" says Mr. Jackson.

There has been a steady diminution in the number of boys employed under fifteen during the last quarter of a century. With the recent stimulus given to secondary education, and counting on the zeal of new education authorities, there is reason to believe the decrease may be even more marked in the next census return. There are, however, exceptions to this decrease. The census general report of 1901 states, " while owing to the restriction of child labour, the total number of boys under fifteen years, returned as employed, showed a decrease of 12·9 per cent. on the numbers enumerated in 1891, the number of messenger boys at the same ages declined by only 5·1 per cent." It is, however, satisfactory to note how few are the trades in which an actual or a proportional increase in the number of boys is shown. As Mr. Jackson says, messenger boys have a very short life as such, and this form of occupation ceases as soon as the boys begin to require higher wages. It is unfortunate, therefore, that it should be just in this class that the decrease in boy employment is least marked.

The problem presented by the results of Mr. Jackson's inquiry is very grave in character, and the various statements of it collected in the present volume may be commended to the careful consideration of those who administer our educational affairs. Similarly, the opinions here collated of schoolmasters, of men working in boys' clubs, &c., of trades unionists, of distress committees, and others, deserve earnest study.

The analysis of the numerous forms received by Mr. Jackson proved a long and difficult task, and he is to be congratulated upon the important facts he has been able to gather together. The information respecting the capacity of boys, the wages they are able to earn, and the precise conditions regulating boy labour in specially selected industries, will repay careful deliberation, and may with advantage occupy the time and immediate attention of the members of education committees throughout the country.

Of especial interest are the conclusions arrived at and the suggestions which Mr. Jackson makes at the end of his report. The following excerpts will serve to show the vital importance of early legislation to ensure some efficient system of further education for all boys and girls during their adolescent years, whether they themselves desire it or not.

The evidence as to the difficulty boys find in getting into permanent work of a satisfactory kind seems overwhelming. Every inquirer gives the same impression.

The work of an errand boy or a telegraph messenger is bad for the boy, so is the work of a boy in a warehouse or factory who is employed to fasten labels to bottles, to fill packets of tea, or the like. It is not so much a question of a skilled trade not being taught as of work which is deteriorating, absorbing the years of the boy's life when he most needs educational expansion in the widest sense.

Mere skill of hand or eye is not everything. It is character and sense of responsibility which requires to be fostered, and " not only morals, but grit, stamina, mental energy, steadiness, toughness of fibre, endurance," must be trained and developed. Work which is monotonous kills development, and work which is intermittent destroys perseverance and power of concentration. The waste of boys' brains, character, and strength is ultimately not only destructive of the individual, but a serious economic loss to the community. It is probable that boy labour is not really cheap at all, owing to the undeveloped responsibility and carelessness of the young, but if the unskilled men who spring from them have been mentally and physically stunted, the loss to the employers is enormous, for they cannot earn a sufficient wage to live properly, and their output is below that required from an adult citizen.

In the large industries there should be a readjustment of conditions, but probably the initiative must come from an extension of State regulation of boy labour. This can be most easily effected by further raising the age of school attendance, or by a system of compulsory continuation schools. It must be recognised that much boys' work is wholly uneducative, and deteriorates instead of developing the man, and that this must be prevented. One of the largest industries—the textile—is still partly based on half-time child labour. It is probable that the operatives are really more to blame for this than the employers, many of whom are not very satisfied as to the advantages of child labour. The old contention that the manipulative skill required compelled the employment of children of twelve, because after that age their fingers lose suppleness, is not now heard so frequently.

One thing which appears likely to be of far-reaching benefit to the boy is increased education. Thus Mr. Kittermaster gives as his remedies:—

(1) Boys should be kept at school until the age of fifteen instead of fourteen.

(2) Exemption below this age should only be granted for boys leaving to learn a skilled trade.

(3) There should be school supervision until sixteen, and replacement in school if not properly employed.

Prof. Sadler and the Rev. Spencer Gibb suggest compulsory half-time schools, or, at any rate, some compulsory school until sixteen or seventeen. Mr. Gibb would like to see further amendments of the Shop Hours Acts so as to avoid the possibility of excessive hours of labour on certain days of the week. He points out, also, that the present Acts need to be more thoroughly enforced.

This inquiry seems to show that these reforms are necessary. The raising of the age of exemption would strengthen the boy, and he would be kept longer under discipline, and would become both steadier in character and more intelligent. It can hardly be seriously contended that the boy of the working man is really more fit for life than the public-school boy at the age of fourteen who is admittedly unready at that age.

It must not, however, be supposed that the present education given in the schools is all that can be desired.

There is a widespread feeling that it is too academic, and must be made more practical. In any case, it must aim at developing character and intelligence rather than merely imparting book knowledge.

If it is urged that further time for schooling is commercially impossible, it must be remembered that our great trade rivals, the Germans and the United States, have compulsory continuation schools or a higher exemption age. In Germany it is the custom for parents to put their boys to a skilled trade, and apprenticeship is as flourishing there as ever it was. "The Imperial Law on the 'Regulation of Industry' of 1891 decreed that the masters in any branch of industry were bound to allow their workers under the age of eighteen to attend an officially recognised continuation school . . . for the time fixed as necessary by the authorities." The local council might make such attendance obligatory for all male workers under the age of eighteen. Every raising of the school age or Factory Act limiting child labour has been in turn objected to as fatal to industry, but the community has very quickly adapted itself to the new conditions.

The removal of the supply of cheap boy labour under fifteen would probably lead to very useful readjustments of industry and to the substitution of mechanical labour for some of their work and for a greater employment of adult labour. It is, of course, true that to start boys at fifteen instead of thirteen or fourteen will not prevent a period of transition from boys' to men's jobs, but it will give a better chance of skill to the boy. A better and longer education should give the boys firmer and more disciplined characters and a greater power of adapting themselves to new work. Increase of efficiency, even in unskilled labour, means increased wage to the mutual benefit of employer and employed. It is the over-supply of unskilled labour which is not worth a good wage which is the real difficulty.

Again, in skilled trades proper there is little doubt that there is room for more boys, and they are not supplied now with the best material available. It is probable that labour exchanges for boys leaving school would be of very great value in securing that all the more intelligent and able boys had a chance of securing good openings. It is the ignorance of the boy which so often leads him into employment which is not suited to him.

Further, some better grading of wages is most desirable. At present, comparatively high initial wages are often paid to tempt boys into an unprogressive occupation. The value of the old apprenticeship scales lay in their attempt to make the wage increase with the capacity, but the low initial earnings have been the reason of the unpopularity of apprenticeship with the more needy and less far-sighted. It is quite possible that the boy leaving school at fifteen will still not earn more than he now does at fourteen. There is little doubt that in that case the employer would gain, because he would get a better article, but the boy would also gain, because he would be a better article and more fit to develop into a still higher efficiency, commanding better wages later. It is better that he should be paid less in his early years and be worth more as an adult. Under existing conditions he is bribed by large wages to spend his time on uneducative work which gives him no opportunity afterwards, and he is unfit to spend wisely the large wages which he receives. The present system demoralises the boy. The temptation to leave one job to get higher wages in another is almost irresistible, and the resulting instability is detrimental to himself and not economical to his employer, who is perpetually trying to train new boys.

EVOLUTION IN APPLIED CHEMISTRY.[1]

EVERY chemist, to be worthy of the name, should in his own work be a specialist; but there are few amongst us to whom it has been given to produce in their own particular line of research results of deep general interest. Our distinguished president, Sir William Ramsay, is one of the privileged few; I am one of the many, whose scientific results are like the grains of sand, the importance of which lies in their aggregation.

But a chemist, to be worthy of the name, should also be able to step forth from his own small sphere of activity and to look upon his science and allied domains of human thought as a whole, to contemplate its history and its future, its aims and progress, and to glean a few useful truths from such considerations. This is what I shall try to do.

The simple daily wants of mankind in a primitive condition are all supplied by nature. It is the progress of civilisation which led to the necessity of transforming her gifts, and thus created a chemical industry. Human chemical work supplements the chemical work of nature, and is therefore subject to the same governing laws. It is strange that no attempt has yet been made to trace the many coordinated points which exist between biology, the science of life, and chemistry, the science of molecular changes, without which life is an impossibility.

The subject is extensive enough for a book. I cannot hope to do justice to it in a short lecture, but I shall try to point out some of the relations existing between the results of biology and applied chemistry.

Biology as a science is of very recent date. The manner in which our forefathers tried to gain an insight into the overwhelming variety of the vegetable and animal kingdoms was purely systematic. Linnæus, de Candolle, Cuvier, and others, enabled us by their systems to classify nature, but they did not teach us to understand it. Hardly a century ago the dawn of a deeper insight began to rise on the horizon of science, and just fifty years have elapsed since that memorable meeting of the Linnean Society in which the flaming truth of evolution was given to humanity by one of the greatest minds that ever stood up amongst men. Botany and zoology, the pedantic histories of plants and animals, became suddenly united in biology, the great science of life, itself a living thing, capable of development and evolution.

Evolution is no longer a working hypothesis of natural science; it has become a new way of thinking, a method of harvesting everlasting truth from the fleeting changes of passing life. It is not applicable to living plants and animals only, but to everything that is capable of growth, alteration and improvement. Why should this method not be extended to the study of human achievements, of science as a whole? Why not to applied chemistry, which is so full of changes, and more vigorous in its growth and development than many another discipline?

It seems to me that England, the country which has given to all the other nations the invaluable gift of evolution, is the classical soil on which an attempt might be made to apply it in a new manner. It may help us to understand, and therefore to forgive, the struggle for existence, which in chemistry and its applications is as rife as amongst the organisms of the deep sea or the tropical forest. Looking at that struggle with the calm soul of the man of science, we shall easily recognise the underlying promise of the survival of the fittest and of certain progress in coming days.

As a rule, one takes it for granted that anything applied must have existed before its applications. It is not so with applied chemistry. Chemistry as a science is, as we all know, a comparatively new creation. Its applications, on the other hand, have existed since times immemorial, and may be traced back to the very beginnings of human civilisation. The men who in the past devoted their thought and energy to problems which we now call chemical had to reach their ends with the help of sound empiricism. Though their progress was slow it was sure, so that to this day we have sometimes occasion to marvel at their successes. More than that, we may safely say that some of our best industrial methods would never have been discovered if we had had chemical theory only to guide us. Science itself stands on an empirical basis—we cannot draw general conclusions unless we have well-established observations to start from.

It is perhaps not superfluous to remember these facts at the present time, when the brilliant success of theoretical chemistry is apt to make us forgetful of the services derived from purely empirical methods of research. Empiricism investigates without foregone conclusions,

[1] Address to the combined sections of the Seventh International Congress of Applied Chemistry on Monday, May 31, by Prof. Otto N. Witt, of Berlin.

whilst theoretical science verifies logical deductions. Science forces nature to divulge its secrets; empiricism is quite content to pick up the treasures it may come across in its ramblings through unexplored regions. Nature is still full of unknown treasures. Why should we cease to search for them? Why should we expect success only from logical deduction?

It is true that the scientific method of invention is a quicker road to success. Rapidity is everything in our times. Whirling along in a motor carriage to a well-known destination is distinctly more agreeable than tramping on foot in the glaring sun of a summer's day; but you cannot pick the flowers blooming by the roadside or stumble over hidden treasures at the rate of sixty miles an hour. The two methods of progress have both their own peculiar advantages, and should both be followed. Now and then they will meet, and make success doubly certain.

One of the best combinations of empiricism and theory is the examination of old empirical industrial processes by the methods and in the light of modern chemical science. A great deal of valuable information has been obtained in this way; much more remains to be discovered. It is this conviction which led me to propose to the last congress at Rome that a special section should be established in these congresses for the history of applied chemistry. The history of chemical science, as it exists now, is almost entirely devoted to theoretical systems and to the life of those who created them. The history of industrial methods is not so complete as one might wish it to be.

So far as the history of our nineteenth-century chemical industry goes, the materials for studying it are not wanting. The patent literature of the various countries is in itself an inexhaustible source of information, which can be largely supplemented from text-books and endless files of periodicals; but it is not so if we begin to inquire into the applied chemistry of previous centuries. The mysterious communications of the mediæval alchemists have been frequently examined; but Pliny remains our almost exclusive source of information about the chemical arts of the antique world. Yet these arts were many and highly developed, and Pliny's information was distinctly superficial.

How much more might be gathered about the chemistry of past times has been shown by the researches of such men as Berthelot and Edmund von Lippmann, who combined the accomplishments of distinguished chemists with those of the Orientalist in the study of Arabic and Hebrew authors. Who knows what a host of information may yet be lying dormant in unread Egyptian papyri and palympsests?

But the sovereign means of discovering these lost secrets is in the careful study and analysis of the products which ancient times have fortunately left us as proofs of their skill and knowledge. How much has been done in that respect by that one great master, Marcellin Berthelot, who found in such work the recreation of the later years of his life? How much more remains still to be done?

Thus we may hope to know at some future time more of the accomplishments of past generations than we do at present; and we may also hope that some of the methods thus re-discovered will awake to fresh life like mummy wheat, which is said to take root and grow if you plant it in fresh soil. Have we not greeted with delight the *terra sigillata* of the Romans, when the process for its manufacture was re-discovered by Fischer, a Bavarian potter, and has not a considerable industry sprung from the resurrected use of lanolin, or wool-fat, which was a panacea of the Greeks two thousand years ago?

Yet such discoveries will remain inheritances from the dead, and the cases of their resurrection to life will not be numerous; but we have living empiricism at our doors, which we allow to die and to sink into oblivion, without attempting to study it and to learn the lesson it has to teach—a treasure of information of incalculable magnitude hoarded up in the course of centuries by the skill and patience of countless millions of men who were, and are, as keen in the study of nature as they are reluctant to draw general conclusions from their observations.

This great treasure is the industrial experience of the Eastern nations. It is an undoubted fact, and if it were not, a single visit to the South Kensington Museum would prove it, that the people of Persia, India, China, Japan, the inhabitants of Burma, Siam, Cambodja, and the innumerable islands of the Pacific, are possessed of methods for the treatment and utilisation of the products of nature which are in many cases equal, if not superior, to our own. These methods must be to a large extent based upon chemical principles. Is it not strange that we know so little about them, and that little generally only indirectly through the accounts of travellers who were not chemists? If all these peculiar methods were fully known and described by persons who have seen them applied and watched their application with the eyes of a chemist, it would certainly be, not only of interest, but also of the greatest utility to our own industry; for it is the elucidation of empirical methods which, in the new light that science sheds upon them, leads to new departures and to progress. Who can deny the advantage which the industry of cotton dyeing and calico printing derived from the study of the Turkey-red process, which a century ago was bought as an Eastern trade secret by the French Government and generously placed at the disposal of European dyers? Would the making of porcelain have been invented in Europe if the impulse for it had not come from the East? Is there no connection between the introduction of Chinese porcelain and the invention of Delft, the curious observations of Réaumur on devitrification, and even the work of that great and original genius, Josiah Wedgwood? And would that supreme triumph of the application of pure chemical science to industry, the synthesis of indigo, ever have been accomplished if indigo, as a natural dyestuff, and its extraordinary method of application by vat-dyeing, had not come to us from the East? What a stir has been created, even in these very latest days, by the extension of this ancient Eastern method of dyeing to other shades than those of indigo!

We live in a period when the intellectual nations of the East wake up from their political sleep of centuries, when they issue from their seclusion and demand their share of Atlantic civilisation; but their awakening means going to sleep for their industrial methods. These methods, ingenious as they undoubtedly are, cannot compete with ours in being applicable on a manufacturing scale. So our processes are transferred to the coasts of the Pacific, and their own methods are abandoned and forgotten. The Eastern industries cannot keep pace with ours, not because they are inferior in their results, but because they toil on foot whilst ours are motoring. In this struggle for existence the fittest means the quickest and the cheapest.

Yet I am certain that many a new and good result might be obtained from the combination of Eastern and Atlantic achievements. Examples of such happy blending are not missing. See what that great and original English inventor, Lord Masham, the very type of an Atlantic genius, has made of the wild silks of India!

It seems to me that these international congresses ought to make it one of their important duties to watch over the intellectual wealth of the past and to collect it before it disappears for ever. Let the chemists of all countries who flock together in these gatherings entrust to their keeping the old indigenous industrial methods of their nations; let the reports of these congresses, which are distributed over all the world, become a treasure-trove of ancient motives for new development!

If we consider how our present chemical industry has been evolved from empirical processes such as our ancestors practised them, and as they still exist in the countries of the East, and even in some parts of Europe, we can easily observe a gradual transformation similar in many respects to the one that living nature had to go through in evolving the present types of plant and animal life. It is here that the parallels between biology and chemistry offer themselves. They are interesting, and not useless to consider. It would be strange indeed if we could not gather some acceptable hints from surveying the broad expanse of the human toil and thought of centuries.

One of the most characteristic changes that have taken place is the transformation of handicraft into manufacture.

We have replaced personal skill by division of labour in chemical work just as much as in all the other branches of human industry. In so doing we have certainly unconsciously copied nature. Do not her earliest creations, the unicellular organisms, in which one cell is made to fulfil all the functions of life, resemble the patient craftsman, who works at the object that he wants to turn out from the beginning to the end, and then, with a last loving glance, hands it over to his client? And are not our factories of the present day comparable to the complicated organisms of the later epochs of creation, with their many coordinated and subordinated organs that work in unison, and in their joint activity are much more powerful than their tiny unicellular ancestors?

One of the most interesting chapters in the evolution of animated life is the gradual transformation of aquatic organisms into those living in the air and on solid ground —a tremendous change, and one which could only be effected by many and varied attempts and by means of the most marvellous adaptations. Right into the midst of our epoch, when the conquest of land as a permanent dwelling-place for plants and animals is practically accomplished, reaches the perpetuation of intermediate forms, which can adapt themselves to land or water, as the circumstances may require.

Now what is the lesson we can learn from the study of this wonderful development in comparing it to what has happened in our own industry? I think it is obvious and of the greatest importance. It is this, that no industry, and especially no chemical industry, can be transplanted, such as it is, from the place in which it has been successfully developed, into any other without having to undergo a complete change, which taxes to the utmost the organising and inventive power of those who make the attempt.

This is a truth too often forgotten in our times, when the keenest struggle for success is rife everywhere, and people who have to suffer from the competition of factories established in other countries are apt to vent their grief in uncharitable accusations. Yet how frequent are the examples, when manufacturers, who have risen to great prosperity, suffer tremendously by transferring their own business into some new locality. In many cases it is merely a move in their own country, yet it means, generally, a far-reaching adaptation to altered conditions; but if it becomes a question of transplanting a manufacture from one country into another, it must be quite a new creation if it is to be a success. As a new creation it should command our respect, and though it may be inconvenient it should not be disparaged. It was the destiny of aquatic organisms to conquer land as a dwelling-place, and it is the destiny of the industrial countries of the present day to carry industry to the nations that are ready to receive it.

There are, fortunately, no two countries alike in this world, and most of them differ, from a manufacturing point of view, more than land and water for plants and animals. Whenever an industry leaves its native country it has to be re-modelled. Take, for instance, the gas industry, which was born in England, and has been carried by English enterprise over all the world. No sooner it crossed the channel and was established in France and Germany than it had to be materially transformed, not in its principle, but in the constructive details and the dimensions of the necessary plant. Our coal was different from yours, our fire-clay had to be prepared and worked differently for the production of the necessary retorts, our condensers and gas-holders had to be altered and encased to withstand the sudden and wide changes of temperature of a Continental climate, our yields proved lower, and the economy of the process was materially different. Still greater changes awaited the gas industry on the other side of the Atlantic. Though the United States are possessed of good gas-coal, the freights for it to the New England States proved to be too high. On the other hand, anthracite was incomparably cheaper there than it is with us, and the same was the case with mineral oils of a high boiling point. All this led to the successful substitution of carburetted water-gas for the illuminating gas of Europe. At present we try hard to acclimatise this American adaptation of the gas industry both in England and Germany. Brilliant as the work done by gas specialists in connection with these attempts undoubtedly is, the success is, to say the least, indifferent, and will remain so until the water-gas question will again have undergone so complete a transformation and adaptation to European industrial conditions that it will once more be paramount to a new creation.

Another example. Just at the present time a new country is about to join the concert of industrial nations. Norway, in the rocky solitudes of which the bear was wont to ramble and the elk and the reindeer to graze, the blue fjords of which knew no other craft than fishing smacks and occasional pleasure yachts, is beginning to develop a chemical industry of vast dimensions. Will that industry be similar to the one existing in this country or in Germany? Certainly not. Its factories will have no chimneys, no fires. They will be activated by the "white coal," the force of roaring torrents. Our engineers have pondered over the problem of economically transforming heat into electricity; the task of the Norwegian manufacturer is just the reverse. One of the fundamental problems of our German chemical industry is the utilisation of our overwhelming wealth of sodium and potassium salts; the Norwegians neutralise their synthetic nitric acid with limestone, because they have no cheap alkali. Many other points of the same kind might be mentioned, but I think these are sufficient to show that, whatever that new Norwegian industry may prove to be, when fully developed it must be different from what the world has seen so far.

The first activity which the human race develops in taking possession of wild districts is agriculture, and we know full well that no two countries are alike in their agricultural methods and results. An agricultural country has to develop a dense population, and, in its work, the peculiarities due to its soil and its climate, before it can attempt to create an industry. The blending of the old agricultural interests with the newly acquired industrial ones means in itself a convulsion. Is it then probable that so fundamental a change may be brought about by the mere importation of a miserable copy of what has been born and nurtured to maturity on other soil and under another sun?

If we study the life of plants and animals we are struck by the marvellous economy reigning everywhere. There are few physiological processes which can be called wasteful. Every bye-product of the more important chemical reactions that take place in the organisms of plants and animals is utilised and made to serve some purpose. In plants, for instance, the refuse of the chemical work of the protoplasm seems to be deposited as encrusting material in the enclosing cellulose. The encrusted cell is then made to serve as a mechanical support for the body of the plant, whilst new and more vigorous cells are formed to fulfil the functions of life. Some of the bye-products of the chemical work of the plant are transformed into dye-stuffs, others into perfumes, both with the object of attracting the insects which are necessary for fertilisation. Everywhere in animated nature we see the principle of storing up food, either to serve in cases of need or to provide for a future generation. Even in those cases where nature seems to be wasteful, as, for instance, in producing germs and seeds in far greater numbers than seem to be required for the continuation of the species, the seeming superabundance is merely a wise calculation of the probabilities for the development of the germs. More marvellous, perhaps, than any of these examples is the economical use of the energy required for sustaining the functions of life. So far as I am aware, there is not a single engine of human invention which can utilise the energy supplied to it in so perfect a way as, for instance, a horse utilises the calories contained in its food for the production of mechanical power; and though the mechanical equivalent of light as a form of energy is, so far as I am aware, yet an unknown constant, we may safely say that the perfection with which living plants utilise the energy of sunlight for carrying out the endothermic reactions upon which their nutrition and growth depends is far superior to the methods which we have so far discovered for similar purposes.

Are not these principles of economy which so universally pervade living nature also the very essence of all industrial chemistry? Are not such considerations as economy of energy in its various forms, high yields, and the avoiding, or, if unavoidable, the utilisation of bye-products the fundamental principles which we try to instil into the mind of the young chemist about to begin his career as a manufacturer? The history of applied chemistry is teeming with examples where the survival of the fittest means neither more nor less than a victory of economy.

We all know that that marvellous creation of human ingenuity, the closed ring of industrial chemical processes working in connection with Leblanc's method of producing soda, is practically extinct on the Continent and materially reduced in its importance in England. This fate it had to suffer, because it was a wasteful process—wasteful in its utilisation of material and wasteful in its consumption of energy. The skill and resource exerted in its invention and constant improvement will for ever be gratefully remembered; but they were unable to check the progress of the Solvay process, which is more economical in its use of energy, and of the electrolytic methods for splitting up the alkaline chlorides, which produce no bye-products.

The progress of industrial chemistry does not always depend on the introduction of more perfect, but also more complicated, machinery and plant into the factories. Of course, every chemical process requires thorough working out from a mechanical point of view, and many of the most brilliant successes of our modern chemical industry are mainly due to a clever adaptation of mechanical means to a chemical end; but, taken as a whole, the real progress of the chemical industry does not so much consist in the improvement of the apparatus as in the simplification of the fundamental chemical reactions. More than once a seemingly insignificant chemical alteration of an industrial process has produced the same or a better effect than the introduction of the most ingenious and costly plant.

That the great principle of economy is not only applicable to the material necessary for carrying out chemical reactions, but perhaps even more to the energy consumed by them, is a distinctly modern idea. It is not so very long since we have begun to have, if I may say so, a conscience for fuel. Previous generations took it for granted that industrial work consumed coal, and that the necessary coal had to be provided and to be paid for. We are now awake to the fact that the quantity of fuel required for an industrial process is very much dependent on the way in which it is made to do its work.

Of course, the calorimetric effect of any given fuel is a constant, and it is also true that we can never utilise more than a certain proportion of it; but this proportion may vary considerably. It was alarmingly small almost through the whole of the nineteenth century, and we may congratulate ourselves upon its present ascendent tendency. A striking example of the transformation of our views about fuel and its proper use is the history of the smoke question. There was a time, both in England and on the Continent, when smoke was considered a necessary evil which had to be suffered. After a while smoke began to be looked upon as a nuisance, and war was declared against it by those who suffered from its disagreeable properties; but now we know that smoke is a waste, and that nobody has better cause to wage war against it than he who produces it. A smoking chimney does not only carry visible unburned carbon into the atmosphere, but in nine cases out of ten also invisible carbonic oxide and methane, with all the latent energy they contain. Smoking chimneys are thieves, and their misdeeds should not rise unavenged to heaven.

But even chimneys that are innocent of incomplete combustion may be guilty of stealing energy if they allow the gases of combustion to escape into the atmosphere with a higher temperature than is necessary to activate the draught. The lost energy of such gases may be trapped and recovered by the regenerating and recuperating apparatus now so largely used by many industries. Regenerative gas-heating is not only a sure prevention of smoke, but also the most powerful means of economising heat, and therefore one of the greatest acquisitions of modern industry. It is perhaps not saying too much that the saving of national wealth effected by it may amount to a sum sufficient to pay the aggregate national debts of all the civilised nations. Uncivilised nations are blessed with neither national debts nor heat-regenerating appliances.

My last comparison between biology and applied chemistry I should like to choose from a chapter which one might call biological sociology, though I am not aware that that name is commonly given to it. It treats of the wonderful phenomena of symbiose and aggregation.

Symbiosis is, as we now know, of very frequent occurrence. Plants or animals of totally different nature and organisation, or even plants and animals, may combine for joint life and activity with the object of helping and protecting each other in the great struggle for existence. What neither of them would be able to fulfil or obtain by its own strength and power they can do with ease and certainty in their faithful allegiance. Gregariousness—the flocking together of organisms of the same kind—arises from the same spirit of mutual help and protection.

There is a great deal in human life and institutions, in our morals, politics, and science, which reminds us that the human race, as an intrinsic part of animated nature, has also inherited its all-pervading tendency for combining forces; and what is thus apparent in the doings of mankind in general cannot be absent in the special field of activity which forms the object of our exertions. The various forms of chemical industry are essentially symbiotic. They depend upon each other for their success and progress. A solitary chemical factory in a country otherwise devoid of chemical industry is a practical impossibility. Chemical works come in shoals if they come at all. The maker of acids and alkalis wants other chemical enterprises to use his products, and these, again, are constantly on the look-out for customers. The more varied and numerous the factories are, the more they prosper, in spite of their complaints of growing competition.

The chemists themselves are gregarious. They form societies and academies and institutes and syndicates by the score, and who can deny the fact that brilliant results have been achieved by such combinations of forces? If we remember, in terms of unmeasured gratitude, the great originators of our science and its applications, we cannot forget the help rendered to its progress by such institutions as the Royal Society and Royal Institution, the French, Italian, and German academies, the leading chemical societies, and the innumerable universities in all parts of the world, the rapid growth and extension of which is the true gauge of our progress.

Last, but I hope not least, in this list of brilliant aggregations stand our congresses as a new, but most successful, creation. They represent a modern form of symbiotic effort amongst chemists, which is the more remarkable because it is international. They proclaim the great truth that science knows no boundaries and frontiers, that it is the joint property of all humanity, and that its adherents are ready to flock together from all parts of the world for mutual help and progress. It is the great truth proclaimed by one of our past presidents, Marcellin Berthelot—"La science est la bienfaitrice de l'humanité entière"—which our congresses might write on their banner, for it expresses the spirit which led to their foundation and ensures their success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. H. KOBOLD, professor of astronomy at the Kiel University, has been called to the similar post at Berlin.

MR. J. E. BARNARD has been appointed lecturer on microscopy in the department of general pathology and bacteriology, King's College, London.

DR. G. S. WEST has been appointed to the chair of botany and vegetable physiology in the University of Birmingham, rendered vacant by the retirement of Prof. Hillhouse.

PROF. W. W. PAYNE has retired from the chair of astronomy at Goodsell Observatory, which he founded at

Carleton College, Northfield (Minn.), in 1877, but retains the co-editorship of *Popular Astronomy*. Dr. H. Wilson, his co-worker, has been appointed to the professorship.

DR. C. GORDON HEWITT has accepted the appointment as entomologist to the Dominion of Canada in succession to the late Dr. James Fletcher, and has resigned, in consequence, his post as lecturer in economic zoology in the University of Manchester. He will leave England in September to take up his new duties at Ottawa.

WE learn from the *Westminster Gazette* that the heirs of the late Herr Heinrich Lanz, head of the Mannheim engineering firm, have given a million marks for the establishment of an academy of sciences at Heidelberg, which will stand in the same relation to the university as the similar institutions in Leipzig and Göttingen stand to the universities in those cities.

LORD STRATHCONA has just presented the sum of 100,000*l*. to the McGill University, Montreal, of which he is Chancellor. Of this amount, 90,000*l*. is needed to complete and equip the new medical buildings, the old buildings having been destroyed by fire in 1907. The remaining 10,000*l*. is intended as a subscription to the fund for increasing salaries throughout the University.

AT the meeting on June 28 of the council of the University of Paris, the rector, M. Liard, announced, we learn from the *Revue scientifique*, a gift by M. Henry Deutsch of 500,000 francs, and an annual grant of 15,000 francs, towards a scheme for the creation of an aëro-technical institute. He also announced a donation from M. Basil Zakaroff of 700,000 francs for the foundation of a chair of aviation in the faculty of sciences of the University.

THE Belfast University Commissioners have made the following, among other, appointments to professorships and lectureships in the Queen's University of Belfast:—professor of economics, Mr. Thomas Jones; professor of botany, Mr. D. T. Gwynne-Vaughan; lecturer in organic chemistry, Dr. A. W. Stewart; lecturer in physics, Dr. Robert Jack; lecturer in bio-chemistry, Dr. J. A. Milroy; lecturer in geology and geography, Dr. A. R. Dwerryhouse; lecturer on hygiene, Dr. W. James Wilson.

NEW buildings in connection with the Merchant Venturers' Technical College, Bristol, were opened by Lord Reay on June 24. The college will, for the future, provide the faculty of engineering in the newly established University of Bristol, and in consequence of this arrangement certain changes in the curriculum and time-table will in all probability come into effect at the beginning of next session. These probable modifications are outlined in a short illustrated prospectus of the day classes of the college which was published recently. There are departments for the study of many branches of engineering, including civil, mechanical, electrical, mining, and motor-car engineering, the last-named subject being in charge of a special professor.

A NEW departure has been made in connection with the faculty of engineering of the University of Liverpool. A special course on refrigeration has been introduced into the honours school of mechanical engineering. The general theory and actual testing of refrigerating machines is included in the course on heat engines, but, in the final year of an honours student's four years' work, a course of lectures and laboratory work on heat engines and refrigerators is provided. In addition, a special optional course has been arranged on refrigerating machinery and cold storages, comprising the design of refrigerating machinery, the construction of cold storages, ice-making plants, and the general practice of refrigeration. This experiment, which constitutes, it is stated, the first attempt in this country to establish special instruction on refrigeration, will be watched with interest.

THE programme of the Summer School of University Extension Students, which is to be held this year at Oxford from July 30 to August 23, covers a sufficient range of subjects to appeal to the most diverse tastes. Pure science scarcely takes the prominent place accorded to it in previous years; we notice, however, that one section of the work arranged is entitled "Italy's Contribution to Science," and will include lectures on Galileo, Vesalius and others, by such well-known authorities as Prof. Osler, Prof. A. Macalister, and Mr. Marconi. In addition to the general course on Italy, lectures and classes have been organised for economic and political science, and a special class on practical map-making will be conducted by Mr. N. F. MacKenzie. Application for tickets, and all inquiries in connection with the meeting, should be addressed to Mr. J. A. R. Marriott, University Extension Office, Examination Schools, Oxford.

WE learn from the *Pioneer Mail* that a vesting order relating to the Tata Research Institute has been issued. The order recapitulates the bequests of the late Mr. Tata, and enumerates other gifts which have been made for the purposes of the institute; it then proceeds to outline the scheme for the government of the institute. The Viceroy is to be an *ex-officio* patron, and the heads of local Governments of India are included as vice-patrons. There will be also a court of visitors, on which the Government of India and the Government of Mysore will be represented, and Messrs. Tata, the sons of the benefactor, will be members during their lives. The director-general of education, the directors of public instruction to local Governments, and professors of the institute will be *ex-officio* members. There will be a council of twelve, a senate, and a standing committee of the court of visitors. The council, on which four professors will serve, will be the executive body of the institute, its proceedings being subject, however, to review by the standing committee referred to. There are now, we learn from the same source, ample resources at the disposal of the governing body of the institute. The sum available for initial expenditure includes building grants of 5 lakhs and 2½ lakhs respectively from the Mysore Durbar and the Government of India respectively, with 1½ lakhs from the Madras Government to be spread over three years, and there are in all 13 lakhs practically in hand. As the endowment is on a liberal scale, the financial future of the institute is assured. It may be added that the actual buildings are estimated to cost Rs. 6,57,000.

THE new buildings of the University of Birmingham were opened by the King and Queen yesterday as we went to press. The following message upon this development of university work has been sent by Mr. Chamberlain to the *Birmingham Gazette*:—"The University formally opened by their Majesties in person to-day is the crowning point of the work undertaken by our city, and endows us with an institution we have long contemplated. His Majesty's consent to perform the opening ceremony is one more example of his constant interest in all that concerns the welfare of his subjects. It singularly enhances the importance of the occasion and distinguishes with his Royal approval the work which has thus been accomplished. Nothing in the history of education in this country is more surprising than the recent growth of university institutions. Formerly our ancestors were satisfied with the three universities of Oxford, Cambridge, and Durham in the whole of England and Wales; now in the last twenty years we have added to them other universities to provide for the wants of the towns and districts which are of provincial importance, and we have found that with the growth of these bodies has come the demand for instruction of the higher kind. Accordingly in many towns a fully equipped university has been established, and higher education has been placed within reach of all. By the generosity of our citizens and the munificence of some personal friends we in Birmingham have been enabled to provide and equip the principal technical departments of our university on a scale which previously has been unattempted in this country; but what we have accomplished is only the beginning. Much still remains to be done. The buildings are complete, and the endowments are altogether inadequate; the foundations have been laid, but the building up of the structure lies with the citizens of Birmingham."

A SCHEME is being developed to provide an interchange of University students between the United Kingdom, Canada, and the United States. The object is to provide opportunities for as many as possible of the educated youth of these countries to obtain some real insight into the life and customs of other nations at a time when their own opinions are forming, with a *minimum* of inconvenience to their academic work and the least possible expense, with the view of broadening their conceptions and rendering them of greater economic and social value. Lord Strathcona has consented to become president for the United Kingdom. The list of vice-presidents includes the names of the Chancellors and Vice-Chancellors of many British universities, the Prime Minister, the Lord Chancellor, and other well-known men. A large and representative committee has also been appointed. Additional objects of the movement are to increase the value and efficiency of present university training by the provision of certain travelling scholarships for practical observation in other countries under suitable guidance. In addition to academic qualifications, the selected candidate is what is popularly known as an "all-round" man, the selection to be along the lines of the Rhodes scholarships. It is hoped to afford technical and industrial students facilities to examine into questions of particular interest to them in manufactures, &c., by observation in other countries and by providing them with introductions to leaders in industrial activity. It is proposed to establish two students' travelling bureaux, one in New York and one in London; to appoint an American secretary (resident in New York) and a British secretary (resident in London), to afford every facility to any graduate who wishes to visit the United States, Canada, or the United Kingdom for the purpose of obtaining an insight into the life of those countries. It is hoped to provide twenty-eight travelling scholarships, fourteen of these being available for universities in the United Kingdom, ten for universities in America, and four for universities in Canada. The total cost of the scheme, inclusive of the maintenance of two travelling bureaux and the provision of twenty-eight scholarships per annum, is estimated at 13,500*l.* for a period of three years, equivalent to an annual expenditure of 4500*l.*, the relative annual expenditure being estimated at 2400*l.* in the United Kingdom, 600*l.* in Canada, and 1500*l.* in the United States. Promises of support may be sent to the hon. secretary, Mr. Henry W. Crees, at the University Club, Birmingham, and it is hoped that all interested in promoting the success of an educational scheme of far-reaching significance in the English-speaking world will contribute financially.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 24.—Prof. J. Cossar Ewart, vice-president, in the chair.—Pressure perpendicular to the shear planes in finite pure shears, and on the lengthening of loaded wires when twisted: J. H. **Poynting.** When a solid is subjected to a finite pure shear the lines of greatest elongation and contraction are not the diagonals of the rhombus into which a square is sheared, but lines making, respectively, $\pm\epsilon/4$ with the diagonals of the square, where ϵ is the angle of shear, and these lines are at right angles to the order of ϵ^2. If we assume that a pressure P is put on along the lines of greatest contraction, and a tension Q along the lines of greatest elongation, we may put $P=n\epsilon+p\epsilon^2$, $Q=n\epsilon-p\epsilon^2$, where n is the rigidity and p is a constant to the second order of ϵ. For equilibrium a pressure $R=(\frac{1}{2}n+p)\epsilon^2$ is required perpendicular to the shear planes. This is zero only if $p=-\frac{1}{2}n$, a supposition for which there is no apparent reason. To keep constant volume a stress may be needed $S=q\epsilon^2$ perpendicular to the plane containing P and Q, a pressure if q is positive. Suppose that a wire is twisted by a torque with axis along the axis of the wire. To keep the volume constant at every point it would be necessary to apply the system of forces R and S from outside. If this system is not applied we may expect the wire to change in length and diameter by amounts calculable in terms of the elastic constants. The change in length should be an increase $dl=Sa^2\theta^2/l$, where S is a function of the constants, given in the paper, a is the radius, and θ is the twist in length l. Such a lengthening has been found to exist for piano-steel, copper, and brass wires when loaded enough to straighten out kinks. For the piano wires tested S was of the order 1, and for the copper and brass wires of the order 1·5. The lengthening of a steel wire 0·97 mm. diameter and 2·3 metres long for a twist of one turn in the length was about 0·0019 mm. This lengthening on twisting should be taken into account in accurate determinations of the rigidity.—The wave motion of a revolving shaft and a suggestion as to the angular momentum in a beam of circularly polarised light: J. H. **Poynting.** When a shaft of circular section is revolving uniformly and is transmitting power uniformly, a row of particles originally in a line parallel to the axis will lie on a spiral of constant pitch, and the position of the shaft at any instant may be described by the position of this spiral. The motion of the spiral onwards may be regarded as a kind of wave motion. Its velocity with a given speed of revolution will only be the "natural" velocity $\sqrt{(n/\rho)}$ of twist waves along the shaft for a certain torque on the shaft. For any other torque the velocity is "forced," and forces from outside must be applied to maintain it at every point where the twist is changing. The group velocity of waves of this kind is zero. Taking a uniformly revolving tube as a mechanical model of a beam of circularly polarised light, and assuming that the relation between torque and energy holding for the model holds also for the beam of light, the angular momentum delivered per second to unit area of an absorbing surface upon which the light falls normally is $P\lambda/2\pi$, where P is the pressure of the light and λ is its wave-length. In light-pressure experiments P is detected by the torque produced on a disc at the end of an arm about 1 cm. The value is therefore about 100,000 times as great as the torque on the same disc, due to the angular momentum. If the angular momentum of circularly polarised light only has this value, there does not appear to be much prospect of detecting it at present.—The effect of a magnetic field on the electrical conductivity of flame: Prof. H. A. **Wilson.** This paper contains an account of some experiments on the change in the conductivity of a Bunsen flame produced by a magnetic field. The current through the flame was horizontal, and the magnetic field was also horizontal, but perpendicular to the current. The ratio of the potential gradient in the flame to the current was taken as a measure of its resistance. The results show that $\delta R/R=AH^2+BH$, where H denotes the magnetic field, R the resistance, and A and B are constants. The velocity of the negative ions can be calculated from the term AH^2, and the result is 9600 cm./sec. for 1 volt per cm., which agrees with Mr. E. Gold's results obtained by an entirely different method. The term BH is presumably due to the upward motion of the flame gases, but its value is about fifty times greater than the value calculated from the ionic theory.—Studies of the processes operative in solutions; xi., the displacement of salts from solution by various precipitants: Prof. H. E. **Armstrong** and Dr. J. V. **Eyre.**—The thermal conductivity of air and other gases: G. W. **Todd.** The paper gives an account of a determination of the thermal conductivities of air and other gases at atmospheric pressure. The conductivity was obtained from observations of the steady flow of heat between two horizontal circular metal plates maintained at different temperatures, the upper one at the temperature of steam and the lower one at room temperature. The upper plate was fixed, and the lower one could be moved up and down so as to vary the distance between them. If the temperatures of the plates are kept constant, the quantity of heat passing per second from the upper plate to the lower, when the distance between them is x, is given by $Q=K/x+R+Ex$, where the constant K is proportional to the thermal conductivity, R is the heat radiated, and Ex is the effect due to the edge. The latter is negligible when x is small compared with the radius of the plates, so that the relation between Q and x is given by a rectangular hyperbola. Hence the relation between Q and $1/x$ is a straight line the slope of which gives K, from which the conductivity is determined. The intersection of this line with the axis of Q gives the value R of the radiation. The value of the conductivity so obtained was independent of the nature of the surfaces of the plates, and also independent of the dimensions of the plates, the latter proving that convection currents were absent or negligible. The conductivities of some gases other than air were determined by comparing the rates of flow of heat through them with the rate of flow through air when the plates were at a fixed distance apart. The paper concludes with a calculation of the "radiation constant," from a determination of the absorption coefficient of the surfaces of the plates when painted black, and the radiation R.—The possible ancestors of the horses living under domestication, part i.: Dr. J. C. **Ewart.** By some naturalists it is believed that domestic horses are the descendants of a Pleistocene species (*Equus fossilis*)—now represented by the wild horse (*E. przewalskii*) of Mongolia—by others, the horses living under domestication are said to be a blend of a coarse-headed northern species allied to Prejvalsky's horse, and a fine-limbed southern species which in prehistoric times inhabited North Africa, or a blend of a Prejvalsky-like northern species and a southern species closely allied to *E. sivalensis* of the Pliocene deposits of India. The examination of the skull, teeth, and limb bones of horses found at Roman settlements and in the vicinity of pile-dwellings indicates that domestic horses originally belonged to several distinct types, viz. (1) a type characterised by long limbs, by a long face, broad and convex between the orbits, and strongly deflected on the cranium, and by the crown of the fourth premolar being from before backwards about 2·5 times the length of the grinding surface of its "pillar"; (2) a type with slender limbs, a fine, narrow, slightly deflected face, and the crown of the fourth premolar about three times the length of its "pillar"; (3) a type with fairly slender limbs, a long, narrow, somewhat deflected face, and the crown of the fourth premolar about twice the length of its "pillar"; (4) a type characterised by short, broad metacarpals, a short face, broad and flat between the orbits, and nearly in a line with the cranium, and by the crown of the fourth premolar being twice the length of its "pillar"; and (5) a type with short, wide metacarpals, the face long and strongly deflected, and the crown of the fourth premolar about 1·5 times the length of its "pillar." Only the varieties characterised by molars with short "pillars" are dealt with in this communication. The possible ancestors of the short-pillared varieties are *Equus sivalensis* of Indian Pliocene deposits, *E. stenonis* of the Pliocene deposits of Europe and North Africa, and a new species, *E. gracilis*. Arabs, barbs, thoroughbreds, and other modern breeds with a long deflected face, broad and prominent between the orbits, and the limbs slender, seem to have mainly sprung from *E. sivalensis*, while certain unimproved breeds with a deflected face, but very short "pillars," are probably related to *E. stenonis*. Exmoor, Hebridean, Iceland, and other ponies of the "Celtic" type, as well as ponies found in the south of France, the West Indies, and Mexico, characterised by a fine narrow skull, slender limbs, and the absence of ergots and hind chestnuts, are regarded as the descendants of *E. gracilis*, which includes (1) the small species of the English drift described by Owen as a fossil ass or zebra (*Asinus fossilis*); (2) the small species of French Pliocene and Pleistocene deposits known to palæontologists as *E. ligeris*, and the small species of North African Pleistocene deposits known as *E. asinus atlanticus*, and hitherto believed to be closely related to, if not the ancestor of, zebras of the Burchell type. By crossing experiments evidence has been obtained of the wide distribution of horses of the *E. gracilis* type; that broad-browed Arabs and thoroughbreds, with the face nearly in a line with the cranium, are mainly a blend of a southern variety of *E. gracilis* (*E. caballus libycus*) and a horse of the "forest" or Solutré type, and that heavy breeds have not inherited their coarse limbs from a species closely allied to the wild horse of Mongolia.—The alcoholic ferment of yeast-juice; part iv., the fermentation of glucose, mannose, and fructose by yeast-juice: A. **Harden** and W. J. **Young.** (1) Mannose behaves towards yeast-juice, both in the presence and in the absence of added phosphates, substantially in the same manner as glucose. (2) Fructose resembles both glucose and mannose in its behaviour, but in presence of phosphate is fermented much more rapidly than these sugars, and the optimum concentration of phosphate is much higher. (3) Fructose has the property of inducing rapid fermentation in presence of yeast-juice in solutions of glucose and mannose, containing such an excess of phosphate that fermentation is only proceeding very slowly. No similar property is possessed by glucose or mannose. These properties of fructose indicate that this sugar when added to yeast-juice does not act merely as a substrate to be fermented, but bears some specific relation to the fermenting complex. All the facts are consistent with the supposition that fructose actually forms a part of the fermenting complex. When the concentration of this sugar is increased, a greater quantity of the complex would be formed, and, as the result of this increase in the concentration of the active catalytic agent, the juice would become capable of bringing about the reaction with sugar in presence of phosphate at a higher rate, and at the same time the optimum concentration of phosphate would become greater, exactly as is observed.—The electrical reactions of certain bacteria applied to the detection of tubercle bacilli in urine by means of an electric current: C. **Russ.** The aim of these experiments was to ascertain whether bacteria suspended in an electrolyte are transmitted during electrolysis to either electrode, with the view of the recovery of pathogenic bacteria from a pathological fluid by such means. During electrolysis of certain salts in which bacteria were suspended, the organisms were found to migrate to one electrode; in some instances there was no migration. The effect was noticed to occur with killed as well as with living bacteria. By testing certain organisms in the same (but a small) series of electrolytes some differences of effect were found, though this line of inquiry was not pursued. To utilise this bacterial movement, an electrolyte in which tubercle bacilli had shown marked kathodic aggregation was added to tuberculous urine, and the kathode arranged in the form of a bacterial trap. After electrolysis tubercle bacilli entered the trap, which was eventually withdrawn, and the organisms recognised in a stained film prepared from its contents. A series of such urines was tested in this way, and in each case tubercle bacilli were found in the trap. In the final experiment a number of tubercle bacilli (estimated at 500) were added to 100 c.c. normal urine, and their detection attempted by separate investigators by means of the centrifuge and current. By the centrifuge none were found, while the current recovered 128 bacilli. The results of this preliminary investigation may be summarised as follows:—Certain bacteria under the influence of a suitable current aggregate at one or other electrode. The aggregation varies with the nature of the electrolyte, and is probably due to affinity between the products of electrolysis and the bacteria. It occurs with killed as well as with living bacteria. The aggregation by electrical currents affords a means of collection and examination. The differences in behaviour of various bacteria are such as to suggest the possibility of utilising the method for purposes of specific discrimination, but in this particular the data hitherto obtained are not sufficient to warrant definite statements.—The effect of the injection of the intracellular constituents of bacteria (bacterial endotoxins) on the opsonising action of the serum of healthy rabbits: Dr. R. Tanner **Howlett.** In this investigation the effect of the endotoxins of the *Bacillus typhosus*, *Micrococcus pyogenes aureus*, and *B. tuberculosis* on the opsonising action of the serum of normal rabbits has been studied. The endotoxins were prepared by the Macfadyen process, the rabbits were inoculated subcutaneously, and the specimens for counting the number of bacteria ingested by leucocytes were prepared in the usual manner. Human leucocytes were employed, and the counts were made on fifty cells. (A) *Typhoid Endotoxin.*—The results for this endotoxin are approximate only, as agglutination and bacteriolysis are complicating factors. The amount of endotoxin injected was 0·1 mgrm., prepared from an avirulent strain. One day after injection a decided negative phase had developed (opsonic index about 0·2), two days after injection the index was rising (1·4), and attained a maximum on the third day (3·3), after which it fell. Dilution of the serum to 1 in 5 and 1 in 10 tended to increase phagocytosis. (B) *Staphylococcus Endotoxin.*—Endotoxin prepared from an old laboratory strain in a dose of 0·1 mgrm. produced a rise in the opsonic index to 1·6, which persisted for some weeks. Endotoxin (0·1 mgrm.) prepared from a recently isolated strain produced a rise to 2·5. An equivalent dose of staphylococcus vaccine (1000×10^6 cocci) produced a rise of the opsonic index to

1·8, which fell subsequently to a point lower than that with either endotoxin. Estimations of the opsonic indexes made with the recently isolated strain gave results higher than those obtained using the old strain. With another endotoxin, varying doses (0·1, 0·01, and 0·001 mgrm.) all produced marked rise in the opsonic indexes, the rise corresponding with the dose. (c) *Tubercle Endotoxin.*—Injection of 0·002 mgrm. of endotoxin caused a rise in the opsonic index to 1·9 sixteen days after. A similar dose of German tuberculin R. produced hardly any effect. A large dose (1·0 mgrm.) of endotoxin caused a marked negative phase (index 0·5) forty-eight hours after injection, with a subsequent rise to 1·8. Endotoxin (1·0 mgrm.) prepared from tubercle bacilli previously extracted with ether also produced a negative phase, with a subsequent rise to 1·5. (D) *Keeping Power of Endotoxin Solutions.*—Experiments were performed with staphylococcus and tubercle endotoxin solutions which had been kept for seven weeks after preparation; there was little diminution in activity. Other experiments indicate that the solutions deteriorate but little for three to six months after preparation. (E) "*Negative Phase.*"—Experiments indicate that endotoxin produces decidedly less "negative phase" than a vaccine.—The occurrence of protandric hermaphroditism in *Crepidula fornicata*: J. H. **Orton.** *Crepidula fornicata* is a streptoneurous gastropod belonging to the family Calyptræidæ. Individuals of this species associate together permanently in linear series, forming "chains." The chains may consist of from two to twelve individuals. The sex relations of the individuals were noted in about 300 chains. It was found that the individuals which occur at the attached ends of the chains are always females, those occurring near the top of the chains are males, while those about the middle often possess the secondary sexual characters of both sexes. In intermediate positions in the chains occur forms which, in their secondary sexual characters, are intermediate between females and hermaphrodites on the one hand, and between hermaphrodites and males on the other. Thus the chains present a transitional series, beginning with the males, which are the youngest individuals, and ending with the females, which are the oldest individuals. Microscopical examination of the gonad has shown that there is as complete a transitional series in the primary sexual characters as occurs in the secondary ones. All the adults are sedentary, but the young are able to move about freely. One thousand young ones have been examined, and found to be all males. There is, therefore, no doubt that all the individuals begin life as males, and change gradually in the course of their life-history into females. It is highly probable, from known descriptions of allied species, and from observation on species of allied genera, that protandric hermaphroditism is common in the Calyptræidæ. Further, it seems probable that the family will present a series in the evolution of protandric hermaphroditism. If such a series be found there is little doubt that a study of the earlier stages would lead to the discovery of the nature of the sexes, *i.e.* in Mendelian terms, whether the male is heterozygous and the female homozygous, or *vice versâ*. Ten other streptoneurous hermaphrodites are known. It would seem, therefore, that one of the chief distinctions between the Streptoneura and the Euthyneura is beginning to break down.—Sensitive micro-balances, and a new method of weighing minute quantities: B. D. **Steele** and K. **Grant.**—The polarisation of secondary γ rays: Dr. R. D. **Kleeman.**—The absorption of homogeneous β rays by matter, and on the variation of the absorption of the rays with velocity: W. **Wilson.** The experiments were made with the view of determining the manner in which the absorption coefficient of the β rays varies with the velocity. Radium, which gives out rays the velocities of which vary between very wide limits, was used as a source of radiation. A beam of rays from the radium passed into a magnetic field, by means of which approximately homogeneous rays could be brought into an electroscope. The velocities of the rays could be determined from the strength of the magnetic field. Screens of metal of different thicknesses were interposed in the path of the rays, and it was found that the law of absorption was not exponential, but approximately linear, except for large thicknesses of absorbing material. Various experiments were made to show that this was not due to the experimental arrangement, but was a real effect. The fact that the β rays from uranium, actinium, &c., are absorbed by matter according to an exponential law is shown to be a proof, not of their homogeneity, but of their heterogeneity. Groups of rays can be built up which represent the properties of these rays with respect to absorption. Further experiments were made on the change of velocity of the rays after passing through absorbing material, and it was found that the velocity of the rays, contrary to the view expressed by H. W. Schmidt, is appreciably reduced as they penetrate matter. The law of absorption of the β particles when measured by the ionisation method involves a considerable number of factors, and, as might be expected, no simple relation could be found between the absorption of the rays and their velocity.—Experimental researches on vegetable assimilation and respiration; v., a critical examination of Sachs' method for using increase of dry weight as a measure of carbon dioxide assimilation in leaves: D. **Thoday.**—The reproduction and early development of *Laminaria digitata* and *Laminaria saccharina*: G. H. **Drew.** The processes of reproduction and early development in both *L. digitata* and *L. saccharina* are very similar. The plant is the gametophyte, and is monœcious. The reproductive areas occur as dark patches on the lamina, and consist of gametangia embedded among paraphyses. The gametangia contain small spherical gametes, 0·003 mm. in diameter, and a number of globules of an oily substance. When mature, the gametangia rupture at their distal extremity and liberate their contents. The liberated gametes develop two flagella of different lengths, which are inserted close together; they are phototactic, and move in the direction of the longer flagellum. Cultures from the reproductive areas were made in a culture solution consisting of various salts dissolved in sea water. The solution was sterilised by heat, and all flasks, pipettes, &c., were sterilised by boiling. Division cultures containing the planogametes were made, and eventually cultures free from growths of the Ectocarpaceæ and other algæ were obtained. In such cultures, stages of isogamous conjugation, resulting in a spherical zygospore, were observed. Later a process grew out from the zygospore, and expanded at its end, and then the cell contents passed along this process, forming a spherical mass at the expanded end. This became cut off by a cell wall, and the remains of the zygospore degenerated. The cell thus formed developed chromoplasts, increased in size, and divided, producing typically a chain of cells each having an outer and an inner cell wall. This stage probably represents the sporophyte (2x) generation. Any cell of the chain may then rupture its outer cell wall, and by repeated divisions give rise to the laminaria plant which emerges from the ruptured exosporium. The young plant consists of a flattened lamina made up of cubical cells, having at its base a number of colourless unicellular rhizoids. The stipe is developed from the basal part of the lamina. The disc-shaped expansion develops at the base of the stipe and partially envelops the primary rhizoids; the hapteres arise as outgrowths from this disc.—The germicidal action of metals, and its relation to the production of peroxide of hydrogen: Dr. A. C. **Rankin.**—Surface flow in calcite: G. T. **Beilby.**—A preliminary note on *Trypanosoma eberthi* (Kent)—(*Spirochaeta eberthi*, Lühe), and some other parasitic forms from the intestine of the fowl: C. H. **Martin** and Miss Muriel **Robertson.**—The spectrum of magnesium hydride: Prof. A. **Fowler.** The author has previously discovered that many of the band lines peculiar to the sun-spot spectrum are identical with lines composing the green fluting attributed to magnesium hydride by Liveing and Dewar. The present paper gives the results of a further investigation of this spectrum with high dispersion, together with details of wave-length determinations. The principal results may be briefly summarised as follows:—(1) No sufficient reason has been found for modifying Liveing and Dewar's conclusion that the spectrum is produced by the combination of magnesium with hydrogen. (2) Lines are shown at short intervals in all parts of the spectrum from the extreme red to λ 2300, and definite groups of flutings begin at 5621·57, 5211·11, 4844·92, 4371·2, and near 2430. (3) From photographs of the magnesium arc in hydrogen at low pressures, taken with a 10-feet concave grating, the positions of close upon 2000 lines, composing the three principal bands, have been determined. The wave-lengths were derived from the interference standards of Fabry and Buisson, but have been corrected to Rowland's scale to facilitate comparison with solar spectra. (4) Twelve of the series of lines which compose the green band have been traced, and it is shown that none of the formulæ which have been proposed is sufficiently general in its application to represent all of these series within the limits of error of measurement. For the longer series the closest approximation is given by Halm's equation. (5) The identification of magnesium hydride in the sun-spot spectrum has been fully confirmed, and is clearly demonstrated by photographs submitted for reproduction. (6) It is shown that many of the bright interruptions of the dark background of the spot spectrum are not bright lines, but merely clear interspaces between lines or groups of lines in the spectrum of magnesium hydride. (7) The presence of the magnesium hydride flutings, together with flutings of titanium oxide and calcium hydride discovered at Mount Wilson, accords with the view that spots are regions of reduced temperature, and that their darkness is at least partly due to absorption. (8) The investigation of the possible presence of lines of magnesium hydride in the ordinary solar spectrum is for several reasons inconclusive, but there is evidence that very few, if any, of the thousands of faint lines tabulated by Rowland are to be accounted for by this substance.—The discovery of a remedy for malignant jaundice in the dog, and for redwater in cattle: Prof. G. H. F. **Nuttall** and S. **Hadwen**.—The comparative power of alcohol, ether, and chloroform, as measured by their action upon isolated muscle: Dr. A. D. **Waller**.

EDINBURGH.

Royal Society, June 21.—Dr. Burgess, vice-president, in the chair.—The pharmacological action of protocatechyltropeine: Prof. C. R. **Marshall**. Like most other tropeines, this substance paralyses, but only for a short period, the so-called vagal endings of the heart; it also depresses the neuro-muscular junctions in voluntary muscle and the muscular tissue itself. Its most interesting action, however, is upon the respiration. Medium doses, intravenously administered, rapidly paralyse the respiration. This effect is generally transitory, and is not concomitant with other effects produced by the compound. Tappeiner and Pohl have observed similar transitory effects after intravenous injection of other derivatives, and Pohl's explanation, which ascribes the effect to paralysis of the respiratory centres, was shown to be the true one for protocatechyltropeine. The relation between chemical constitution and pharmacological action as exemplified in the tropeines was considered, and an attempt made to show that definite action could not with certainty be attributed to the two constituent groupings of the tropeines.—The toot poison of New Zealand; an investigation into its pharmacological action: Prof. C. R. **Marshall**. This poison, which includes three definite species of Coriaria, has proved a serious hindrance to the rearing of stock in New Zealand. The active principle, isolated by Easterfield and Aston, is a glucoside named tutin. The effects produced are chiefly stimulation of the medullary centres and epileptiform convulsions, which are mainly of cortical and pontine origin. Pontine convulsions are very susceptible to anæsthetics. A fall of temperature always occurs after the administration of tutin. The substance also depresses the sentient centres, and in man causes loss of memory. Coriamyrtin and picrotoxin have a similar action, but are more powerful, and in some respects more transient in action, than tutin.—Hydrolysis of salts in amphoteric electrolytes: Miss H. H. **Beveridge**. The two principal methods in general use for determining the degree of hydrolysis of salts—catalysis of methyl acetate and electrical conductivity—give results in the case of salts of amphoteric electrolytes which are not at all concordant. The hydrolysis of anthranilic hydrochloride was therefore investigated by several independent methods. Of these, the solubility, distribution between two solvents, catalysis of diazo-acetic ester, and electromotive force all pointed to the catalysis values being correct, while values obtained from depression of the freezing point and electrical conductivity differed widely from these. The divergence was due, not to any abnormality in the degree of ionisation of the salt, nor to the speed of the ions, but might be explained by the assumption of some association of molecules and ions.—Seismic radiations, part ii.: Dr. C. G. **Knott**. Following up results regarding reflection and refraction of seismic disturbances given twenty years ago (see also *Phil. Mag.*, 1899), the author calculated the surface disturbances which accompany the reflection of the various types of elastic wave at the surface of an elastic solid. When the incident wave is condensational there is always a reflected distortional wave as well as a reflected condensational wave, and a simple harmonic disturbance produces at the surface a simple harmonic disturbance along a line differing at most incidences by a few degrees from the direction of the incident disturbance. When, however, the incident wave is distortional there is, after a certain critical angle, no reflected condensational wave. For incidences greater than this critical value the original simple harmonic motion of the incident wave is not, in general, accompanied by a simple harmonic motion of each particle of the surface, but each point of the surface is thrown into elliptic motion of all degrees of ellipticity from circle to straight line. Details were worked out for certain assumed values of the elastic constants. The results indicate how misleading in certain cases is the phrase "emergence angle," much used by seismologists.

PARIS.

Academy of Sciences, June 28.—M. Émile Picard in the chair.—Integral equations of the first species: Émile **Picard**.—The gases of volcanic fumaroles: Armand **Gautier**. The gas samples were collected under experimental conditions designed to exclude the possibility of the admission of atmospheric oxygen, and to preserve gases alterable by water, such as carbon oxysulphide. Gas taken from fumaroles at Vesuvius near the top of the cone was found to consist of hydrochloric acid, carbon dioxide, hydrogen, oxygen, and nitrogen. No sulphur compounds could be detected, and carbon monoxide, oxides of nitrogen, hydrocarbons, and fluorides were absent. Gases collected from fumaroles on Vesuvius eighteen months after an eruption showed hydrochloric acid to be absent, and 0·5 to 2·0 of carbon monoxide present. It was noted that, although no halogen acids could be detected, the gases leaving the fumaroles rapidly attacked steel and copper.—Ordinary carbon: H. **Le Chatelier** and M. **Wologdine**. By modifying the graphitic oxide reaction, graphite has been proved to be present in carbon from acetylene and in other varieties of carbon produced at moderately low temperatures, hitherto assumed to be free from graphite. Carefully purified amorphous carbon from various sources has a density of about 1·8.—The existence of trachytes with quartz (bostonites) in the Mont-Dore *massif*: A. Michel **Levy** and A. **Lacroix**.—The polished stonework in the Haut-Oubanghi: A. **Lacroix**. The ornaments are made of worked and polished quartz; the process of manufacture is described in detail, and shown to be strikingly analogous with similar work in Neolithic deposits.—The origin and evolution of fresh-water shrimps of the family of Atyidæ: E. L. **Bouvier**.—The hydration of potassium carbonate: M. **de Forcrand**. A thermochemical paper.—The action of metallic oxides on methyl alcohol: Paul **Sabatier** and A. **Mailhe**. Alumina, at temperatures about 300° C., furnishes a large yield of methyl oxide; thoria and titanium dioxide at 350° behave similarly; oxides of chromium and tungsten give a mixture of methyl oxide and formaldehyde, the latter being partially split up into carbon monoxide and hydrogen. Other oxides give the latter reaction exclusively.—Observations of the comet 1909*a*, made at the Observatory of Lyons with the bent equatorial of 32 cm. aperture: J. **Guillaume**.—The variations of brightness of Encke's comet and the sun-spot period: J. **Bosler**. The graphical comparison of the variations in brightness of Encke's comet and the number of sun-spots shows that the two phenomena are clearly related.—Comparison of the spectra of the centre and the edge of the sun: H. **Buisson** and Ch. **Fabry**.—The physical and historical interpretation of some markings on the moon's surface; from the eleventh part of the photographic atlas published by the Observatory of Paris: P. **Puiseux**.—An extension of the theory of continued fractions: A. **Chatelet**.—The calculation of the roots of numerical equations: R. **de Montessus**.—Remarks on a note by M. Petit on a new wave detector for wireless telegraphy and telephony: E. **Tissot**. It is suggested that the arrangement of a fine metallic point resting on a crystal of natural pyrites is really one of the thermoelectric detectors.—Comparison between the α rays produced by different radio-active substances: Mlle. **Blanquies**.—The temperature of the oxyhydrogen flame: Edmond **Bauer**. This was found to be 2240° C.—The "initial re-combination" of the ions produced in gases by α particles: M. **Moulin**.—The magnetic transformation of lead: M. **Loutchinsky**. The coefficient of magnetisation is ten times greater in lead crystallised by fusion than in lead hammered out or drawn into wire.—The practical method for the simultaneous calculation of atomic weights: G. D. **Hinrichs**.—The bromide of dimercurammonium, NHg_2Br: H. **Gaudechon**.—The formation of oxygen compounds of nitrogen and their metallic combinations (iron and lead) in the production of ozone for the sterilisation of water: Ed. **Bonjean**. The amount of oxides of nitrogen produced in commercial forms of ozonisers is sufficient seriously to attack lead and iron pipes used in the construction. This has not been considered in the design of sterilisation apparatus on the commercial scale.—The separation of graphite in white cast iron heated under pressure: Georges **Charpy**. Carbon arising from the decomposition of iron carbide produced at temperatures between 700° C. and 1100° C., and under pressures rising to 15,000 atmospheres, separates in the form of graphite.—Contribution to the study of uranyl chloride: Œchsner **de Coninck**.—A new alkaloid extracted from the bark of *Pseudocinchona africana*: Ernest **Fourneau**. The crystallised alkaloid studied has the composition of quebrachine ($C_{21}H_{26}N_2O_3$), and resembles this alkaloid in many of its properties. They differ in rotatory power, quebrachine being dextrorotatory and the new base lævorotatory.—The formation of lactones from acid alcohols: E. E. **Blaise** and A. **Kœhler**. An ε-octolactone can be prepared from the acid $C_2H_5.CH(OH).(CH_2)_4.CO_2H$ by slow distillation in a vacuum, but the ζ-lactone could not be prepared from the next higher homologue in the same way. If the dehydration is attempted by heating with 50 per cent. sulphuric acid, a migration of the hydroxyl group takes place, a γ-lactone being formed in both instances.—Soluble starch: Ch. **Tanret**.—The action of hydrogen peroxide upon crystallised oxyhæmoglobin: I. **Szreter**.—The cholalic acids: Maurice **Piettre**.—Regeneration in species of Syllis: Aug. **Michel**.—The mechanism of the immunity of snakes against the salamandrine: Mme. Marie **Phisalix**.—Concerning a note of M. Devaux entitled "The Relation between Sleep and the Retention of Interstitial Water": Raphael **Dubois**. The author points out that this note confirms his results on the phenomena accompanying sleep in hibernating animals.—The metamorphosis of the splanchnic muscles in the Muscideæ: Charles **Pérez**.—The ratio of the weight of the liver to the weight of the body in birds: J. **de La Riboisière**.—The glacial origin of Loch Lomond and Loch Tay: Gabriel **Eisenmenger**.—The hydrology of the *Bracas* (Basse-Pyrénées) and of El-Torcal (Andalousie): E. A. **Martel**.—The earthquake at Corinth on May 30, 1909: D. **Eginitis**.

NEW SOUTH WALES.

Linnean Society, May 26.—Mr. C. Hedley, president, in the chair.—Metasomatic processes in a cassiterite vein from New England: L. A. **Cotton**. The vein examined lies some six miles south-west of Inverell. A transverse section, about 11 inches in width, was taken and cut into six pieces, in planes parallel to the plane of the vein. Sections were then cut, and a series of four analyses made. Of the latter, three were of the vein, while the fourth was of the country rock, an acid granite. Examination of the slides showed that the central part of the vein was highly siliceous. The remaining slides of the vein-material showed an abundance of a peculiar pale mica of a paragonite-sericite nature. This mica was found to replace the quartz, felspar, and biotite of the acid granite. Fluorite was also found as a secondary mineral, and it is possible that a small amount of topaz was present.—Note on the Guyra Lagoon, N.S.W.: L. A. **Cotton**. The Guyra Lagoon lies immediately to the west of the town of Guyra. It is surrounded by low basalt hills, except for a depression in these to the south-east. The lagoon, which, before 1902, had held water so far back as the oldest settlers in the district could remember, is now dry. There has been no diminution in the rainfall to account for this. It is thought that the changing of the limited catchment area from pastoral to agricultural country may account for the present dryness of the lagoon. Field observations seem to indicate that the depression is a crater-lake.—Note on diurnal variations in the temperature of camels: Dr. J. B. **Cleland**. During the examination of a certain number out of 500 camels in the north-west of Western Australia, a wide diurnal variation in their temperatures, sometimes of 7° F., was met with. This would seem to be due to the high temperature of the atmosphere during the day, coupled with the fact that camels only visibly perspire at the back of the neck over a small area, and the coolness of the nights. The wide diurnal range suggests a resemblance to cold-blooded animals.—Some rare Australian Gomphinæ (Neuroptera: Odonata), with descriptions of new species: R. J. **Tillyard**. The present paper brings up to date our knowledge of Australian Gomphinæ. Five new species are added to the list, and the male of *Austrogomphus risi*, Martin, of which only the female was known, is described.—Studies in the life-histories of Australian Odonata; i., life-history of *Petalura gigantea*, Leach: R. J. **Tillyard**. The species is one of the few remaining forms of a very ancient family.

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