THURSDAY, DECEMBER 16, 1909.

PALÆOZOIC STRATIGRAPHY.

Traité de Géologie. Vol. ii. Les Périodes géologiques. Fasc. i. By Prof. Émile Haug. Pp. 539–928. (Paris: A. Colin, 1908.) Price 9 francs.

THE first volume of Prof. Haug's treatise on geology was noticed in NATURE last year (vol. lxxviii., p. 123), and we now welcome the first part of the second volume, as it is as suggestive, and will no doubt be as useful, as its predecessor. The first volume deals with historical geology, and its first part describes the geological systems—of which the time equivalents are technically valued as periods—from the beginning of the geological record until the end of the Trias. The book continues Prof. Haug's valuable summaries of recent work, his judicious selection of new significant facts and figures, and it is rich in well-reproduced illustrations. It has the merit of being a very cheap text-book, as, though it includes 392 closely printed pages and twenty-eight excellent plates illustrating rocks, fossils and scenery, its published price is only 9 francs. A feature in the first volume that we remarked with regret was the scanty reference to British work; this volume is a great improvement in that respect, as British geology receives its fair share of attention, though the author must have missed several important recent memoirs or he would not have remarked that Carboniferous palæontology has been for a long time past neglected in this country or inserted the footnote on p. 763. The author does not always select for reference the most valued British results, for he quotes Monian and Arvonian, and omits some later more useful terms.

The Palæozoic he divides into four systems—Cambrian, Silurian, Devonian, and Anthracolitic. He subdivides the Silurian into two subperiods, the Ordovician and Gothlandian, and as he admits that they are independent, both stratigraphically and palæontologically, it may be regretted that he does not accept them as distinct systems; for if the name Gothlandian continues to increase in favour, there is a danger that when the two divisions are accepted as separate systems, the term Silurian will fall altogether into disuse. The Devonian system the author adopts mainly on stratigraphical grounds, as he remarks that the fauna alone is insufficient to justify the distinction, as it is so poor in families special to the period.

The volume begins with an introduction to the principles of stratigraphy, and then describes the geological periods in turn. Prof. Haug explains the gradual recognition of the scientific basis and world-wide value of the divisions between the geological systems, for they are due to movements which affected the world as a whole, and by modifying geography and climate produced simultaneous changes in the contemporary faunas and floras. In his account of each system he begins with the history of its classification and nomenclature; he then gives a list of characteristic genera and some notes on the life of the period, illustrated by numerous well-selected figures, such as Ruedemann's Siphonophora-like colony of graptolites with its float. Then follows a brief summary of the distribution of the system through the world, with especial reference to the types of sediments and the relation of the rocks to the transgressions and retreats of the sea. Finally, he gives a sketch of the climate, zoological provinces, and distribution of ocean and continent in the period.

Prof. Haug divides pre-Cambrian time into only two periods, the Archæan and Algonkian. The term Archæan he uses in the sense defined by its founder Dana; he does not go with those—an increasing number—who subdivide the Archæan into two groups, a lower for the massive basal rocks and an upper for the pre-Algonkian schists. The Algonkian he accepts for the comparatively unaltered pre-Cambrian sediments, such as our Torridon sandstone.

One unorthodox feature in the author's classification is his acceptance of one system, for which he adopts Waagen's name Anthracolitic, to include both the Carboniferous and Permian. The suggestion to unite them has been so often made that it is clear that the evidence on its behalf is weighty. It is true that the invertebrate fauna of the Permian is not by itself sufficient to characterise a special geological system, but the great geographical changes and the important development of the vertebrates are strong arguments in favour of maintaining the Permian as a system. The author practically describes the Carboniferous and Permian apart, and together they would make a system inconveniently large and varied.

In the names of the series into which the systems are divided Prof. Haug attaches great weight to priority; thus he rejects the Mississippian of Prof. H. S. Williams because the name had been employed before in a different sense by Marcou, and he appears to regret that he cannot adopt Missourian, instead of the less convenient Uralian, on the ground that the latter is a year older. But as the author rejects Bernician, owing to its having been less adequately defined than the later term Dinantian of de Lapparent, he fortunately allows some discretion in the selection of names. He, however, appears disposed, as a stratigrapher, to pick up the heavy burden of priority which palæontologists are now preparing to throw off.

The account of each geological system concludes with a sketch of its climate, biological provinces, and geography, and the author's work shows the rapid growth in our knowledge of these interesting sections of the earth's history. He directs attention to the numerous Palæozoic glaciations, now proved, including the Huronian described by Coleman at Cobalt, in Canada, the Cambrian discovered by Howchin in South Australia and by Bailey Willis in central China, the Devonian found at Cape Town by Rogers, and the long-known Upper Palæozoic glacials of India, South Africa, and Australia. He rejects the explanation of the last as due to the shift of the South Pole into the Indian Ocean, and attributes the glaciations that occurred in at least four areas of Gondwanaland to geographical causes. He notices the indications of various Palæozoic deserts, but does not mention the desert theory in

connection with the origin of the Old Red Sandstone, which he attributes to formation in a lagoon or in a sea like the Baltic, which had some slight connection with the open ocean. His maps of the distribution of land and water in successive systems are excellent diagrammatic sketches, and those of Europe give the chief facts of its complex history. Prof. Haug is an expert on the geological history of France, and he clearly explains the many important differences between the Armorican region and the Central Plateau; he shows these two areas by different hachures in three out of his four structural maps of Europe, and it is only in that of the Gothlandian (Silurian) that the two regions are shown as sharing the same geological conditions. J. W. G.

SYSTEMATIC BOTANY.

(1) *Illustrations of Cyperaceae.* Prepared under the direction of the late Charles Baron Clarke, F.R.S. 144 plates, with explanation. (London: Williams and Norgate, 1909.) Price 12*s.* 6*d.* net.

(2) *Das Pflanzenreich. Regni Vegetabilis Conspectus.* Edited by A. Engler. 38 Heft, iv, 20. *Cyperaceae-Caricoideae.* By Georg Kükenthal. Pp. 824. (Leipzig: W. Engelmann, 1909.) Price 41.20 marks.

(3) *Das Pflanzenreich. Regni Vegetabilis Conspectus.* Edited by A. Engler. 39 Heft, iv, 83. *Phytolaccaceae.* By Hans Walter. Pp. 154. (Leipzig: W. Engelmann, 1909.) Price 7.80 marks.

(1) "WE hope, Mr Clarke, that you will live a very long time!" Mr. C. B. Clarke was fond of quoting this remark make to him by a well-known botanist, Mr. Henri Baillon, if we remember aright, who appreciated his careful work on the Cyperaceæ, a difficult family of plants, and one of which a good monograph was much needed. Unfortunately, Mr. Clarke did not live to complete the monograph to which he devoted so much time during the last twenty-five years of his life, and in connection with the preparation of which he had visited, or received plants from, most of the important botanical collections. The work was left in manuscript which proved too extensive for immediate publication, and botanists must for the present be satisfied with excerpts of the descriptions of new genera and species, together with a skeleton of the author's arrangement, which have been published in the Kew Bulletin (Additional Series, viii.). For particulars of synonymy and details of geographical distribution, reference must be made to the manuscript which is preserved at Kew. It is to be regretted that it was found impracticable to render accessible by means of publication the full results of the work of so close and careful a student of so difficult a family. It is true, as Mr. Clarke himself was wont to observe when reproached with delay, that much of the work had already been published in the important floras of various parts of the world in connection with which he was invariably laid under contribution for the elaboration of the Cyperaceæ; such, for example, as the "Flora of British India," the "Flora of Tropical Africa," and others; but the *magnum opus* which should correlate the parts and supply a complete account of the family is wanting.

The volume now under review comprises a series of 144 plates prepared by Mr. Clarke to illustrate the monograph, many years ago, when the plan of arrangement had been determined, as well as the representative and typical species of each genus. They have been drawn by various artists—Mr. N. E. Brown, Mr. Charles Fitch, and Miss M. Smith; most have been reproduced by the collotype process, but some by lithography. They are remarkably clear. A characteristic feature is the representation on a large scale of dissections of the spikelets and flowers, with diagrams illustrating arrangement of parts, and enlargements of the fruit—an important diagnostic character in the Cyperaceæ. Facing each plate is an explanatory page of text indicating in many cases the actual specimen from which the drawings were made, such as R. Brown, n. 6020; Burchell, n. 7892. The whole forms an invaluable series of detailed drawings illustrating the floral morphology of the genera and species of Cyperaceæ. Dr. B. D. Jackson, who is responsible for the production of the volume, refers in his preface to the generosity of Miss Clarke, the sister of the author, to which the issue of the plates is due.

(2) Georg Kükenthal has the reputation of a careful worker on the section of Cyperaceæ, a systematic account of which is embodied in this ponderous Heft of the *Pflanzenreich*—the most substantial from the point of view of size that has yet appeared. In the general account which precedes the special descriptive portion, the author refers to the division of the order into subfamilies based on the presumed cymose character of the spike in many of the genera; two subfamilies were at first recognised—Scirpoideæ, with racemose spikelets, and Caricoideæ, in which the spikelets were of a cymose nature. Subsequently, however, the author was led to restrict the Caricoideæ to Carex and a few allied genera, and it is in this restricted sense that the term is employed in the present monograph. As thus limited, the subfamily contains four genera—Schœnoxiphium, a small South African genus of six species, one of which is also represented on the highlands of east tropical Africa; Cobresia, for which the author prefers the more correct to the more familiar spelling, Kobresia (the genus was named by Willdenow in honour of Paul de Cobres); Uncinia, and the huge genus Carex. The author follows Mr. Clarke in including Elyna and Hemicarex in Cobresia, and arranges the twenty-eight species in the four sections suggested by Mr. Clarke. The chief interest of the book, however, is naturally centred in the exhaustive systematic revision of Carex, of which just upon 800 species are recognised. A true estimate of the value of Kükenthal's work on this genus can only be ascertained by experience in its use in the field and in the herbarium; but it is at any rate a great thing to have a carefully elaborated monograph with full specific descriptions and detailed accounts of synonymy and geographical distribution. We have long waited for a successor to Boeckeler's monograph for purposes of arrangement of the species.

(3) The systematic treatment of the order Phytolaccaceæ, by Hans Walter, differs but slightly from that adopted by Bentham and Hooker in the "Genera Plantarum." The three tribes into which the order is there divided—Rivineæ, Euphytolacceæ and Gyrostemoneæ—are here maintained with almost identical limitations. Bentham's genus Stegnosperma, classed in the "Genera Plantarum" as a *genus anomalum*, is regarded by Walter as the type of a distinct subfamily, the order being divided into two subfamilies—Phytolaccoideæ and Stegnospermoideæ, the latter containing the single genus Stegnosperma. There has been considerable difference of opinion as to the limitation of this order, especially in relation to the Ficoideæ, certain genera having been included by different authors in each family. The criterion of one or more than one ovule in the carpel is not a universal one, and the author of the present monograph is convinced that the structure of the inflorescence forms a better means of distinction between the two families. A good proportion of new species is described in the course of the work; thus, of twenty-six species of Phytolacca, seven are here described for the first time.

A. B. R.

THE HAND-LIST OF BIRDS.

A Hand-list of the Genera and Species of Birds. (Nomenclator Avium tum Fossilium tum Viventium.) By R. Bowdler Sharpe. Vol. v. Pp. xx+694. (London: British Museum, Natural History, 1909.) Price 20*s*.

DR. SHARPE may be assured not only of our own congratulations, but of those of ornithologists in general, on the completion of his heavy task and the issue of the final volume of a work the first of which appeared so long ago as 1899. No one who has not tried it can have any conception of the enormous amount of labour involved in a task of this nature, and when we add that the author estimates the total number of distinguishable forms of birds as close upon 19,000, it will be unnecessary further to emphasise the magnitude of the work just brought to a close.

The value of these five volumes to the working ornithologist—whether we altogether agree or not with the author's view as to the limitations of genera, the multiplication of family groups, and the non-recognition of local races—can scarcely be overestimated, although it must always be borne in mind that the work is meant to be used in connection with the British Museum Catalogue of Birds, to the volumes of which references are given under the headings of the various species. In the case of many species, one or two synonyms are given; and almost the only improvement that we could suggest is that in the case of genera and species where well known names have been changed it would have been better if a larger number of synonyms had been quoted, which could have been done without any increase in the bulk of the volume, as there is a large amount of blank paper.

We are glad to see that in the introduction Dr. Sharpe takes the opportunity of making certain amendments in the arrangement of the "orders" of birds, such emendations being, in our opinion, for the most part a decided improvement on his previous scheme. The most important item in this remodelling is the abolition of Carinatæ and Ratitæ as the two main divisions of existing birds, and the inclusion of the tinamus with the ostriches to form one group distinguished by the structure of the palate from a second group containing all other existing birds. When, however, the author proposes to regard these two groups (Neognathæ and Palæognathæ) as equivalent in rank to the one (Saururæ) containing Archæopteryx, we beg to dissent from his views.

In our notices of at least one of the previous volumes of the "Hand-list" we have directed attention to the want of uniformity in the spelling of geographical names. Unfortunately, the author has not availed himself of the hint, with the result that the "pleasing" variety of orthography is more pronounced in the present issue than in any of its predecessors. We have, for instance, Malay Peninsula and Malayan Peninsula on the some page (62), and Malacca in another place; Dentrecasteaux (p. 63) and D'Entrecasteaux (p. 69); Niasa-land (p. 47), Nyasaland (p. 35), and Nyasa Land (p. 474); Cashmere (p. 167) and Kashmir (p. 173); Szechuen (p. 233) and Szechuan (p. 268); Somali-land (p. 184) and Somali Land (p. 465); Damara-land (p. 185) and Damara Land (p. 475); and Island of St. Thomas in one place (p. 463) and S. Thomè Isl. in another (p. 635). We may also note (p. 175) Lipikia for Likipia. In our own experience, the only way to avoid discrepancies of the above nature is to enter every name as it occurs in a list, and to check all subsequent occurrences. With the exception of these discrepancies, which are creditable neither to the author nor to the museum, we have little except commendation to bestow on the volume before us.

For reference purposes, the whole work suffers, however, from the circumstance that the page-headings on both sides are taken up by useless repetitions of the general title, whereas the heading on one side should have carried the family-names. In the case of large families, to find the family-position of a genus it is necessary, after ascertaining the page on which it occurs from the index, to turn back until the family-name is reached, or to refer to the table of contents. In this respect the work compares badly with the "Catalogue of Birds' Eggs." A general index to the five volumes would also have been very useful.

R. L.

SOCIAL EVOLUTION.

Darwinism and Modern Socialism. By F. W. Headley. Pp. xv+342. (London: Methuen and Co., 1909.) Price 5*s*. net.

MR. HEADLEY has given the general reader a comprehensive and well-stated case against Socialism. He brings together the best of the known economic arguments, and bases the whole on biological principles.

The text is that "it is very difficult for a follower of Darwin and Weismann to be a Socialist." In a

survey of early forms of mutual dependence, such as the village community in England and India and the Russian *mir*, he shows that the Socialism, so-called, of the primitive and pre-industrial epochs did not conflict with Darwinian principles. The new Socialism, however, aims at stopping "the struggle for existence" and the elimination of "the unfit."

Much stress is laid all through on the institution of the family, which is a permanent possibility of individualism, and the eternal matrix of capitalism.

The author's view is clear; he avoids irrelevancy, and has the faculty of going straight for the point and of illustrating it by well-chosen examples. Thus he shows that "natural selection" acts only at crises, such as disease or war. In an excellent analysis of the work of our Post Office he emphasises the only relevant points, namely, that all Government departments are wasteful, and that success is really the result of "private" enterprise and of "private" criticism. The same truths apply to "the common sense of municipal trading," a curious hybrid between Socialism and Capitalism. The proofs of all this are well put.

"To abolish private industry would be to kill the goose that lays the golden eggs"; and this is what the Socialist proposes to do. The two chapters which demonstrate this are excellent, and the author has humour as well as insight.

The main defect of our economic system (to which is ascribed the vigour of theoretical Socialism) is excessive accumulation of capital. The main duty of the State is to act as umpire in the competitive struggle. It must not itself produce.

As to minor points calling for criticism, the explanation of the custom of a mock "capture" of the bride as a survival of "bride-lifting" from another tribe is obsolete. Such ceremonies have a psychological origin. The bride is "captured" from her sex and herself.

The frequent objection of Socialists to Christianity is hardly due to a desire to abolish the family. It is rather due to its claim of "authority" and its tendency to Erastianism.

Yet about this book, as about previous applications of "natural selection" to human society, there is something unsatisfactory. False analogy and ambiguity of terms may result, if we forget the fact that in a civilised community survival largely depends on factors which do not exist in "nature."

This doubt may be applied by the reader to chapter ix., the most crucial and the least convincing. It is on "natural selection among civilised peoples."

There is something wrong about the identification of the struggle for existence in the natural world with our competitive system. Transfer a typical unemployed to a state of nature and he would survive. The conditions of the two cases are so different.

Then what is survival-merit now? Mr. Headley speaks of steadiness, honesty, and thrift. An impartial view must add unscrupulousness, low cunning, incapacity for generosity, mercy, and the nobler ideals, for art and culture, and—for conscientious work. Moral values are, of course, a matter of time and place, but there is such a thing as dehumanisation. Add physical survival-merit, and consider if we are not evolving a type which has been described as "a race of men, small, ill-formed, disease-stricken, hard to kill."

He speaks of our lowest class as living in a "primitive" fashion. By its "best blood" the next stratum is reinvigorated. Here is ambiguity of terms.

The selection going on under our competitive system is not necessarily producing "the splendid pattern" of which Mr. Headley and the poet have dreamt.

A. E. CRAWLEY.

A HERO OF MEDICINE.

Semmelweis: his Life and Doctrine. By Sir William J. Sinclair. Pp. x+369. (Manchester: University Press, 1909.) Price 7*s.* 6*d.* net.

"IN the history of midwifery there is a dark page, and it is headed Semmelweis." Semmelweis was a prophet, and he was misunderstood by the people he came to save. The services he rendered mankind cannot be overestimated. His discovery was epoch-making. He established the cause of puerperal fever, and threw light on all septic conditions. Before his time the cause of wound infection was not understood. Semmelweis proved that puerperal fever was analogous to wound fever, both being due to contamination from putrid organic matter. The cause of puerperal fever having been established, Semmelweis worked at its prophylaxis. He insisted on the cleanliness of the patient and her surroundings, and sketched the principles which underlie the antiseptic and aseptic treatment of wounds, and so laid the foundation for modern surgery, gynæcology, and obstetrics. During his life Semmelweis was misunderstood and misrepresented; he met with opposition, jealousy, and hatred from his own profession; he was degraded and belittled; yet, to-day, his conclusions are universally accepted and form the foundation of surgical thought.

There should be a wide public, lay as well as medical, for a book as full of historical, scientific and human interest as this "Life of Semmelweis." It is a just tribute to the memory of a very great man. The only criticism which might be made is that the last hundred pages, dealing with discredited contemporary opinions, might have been curtailed. The early chapters give a vivid account of the conditions under which Semmelweis worked as student and assistant in the great lying-in hospital of Vienna. His attention was soon arrested and his heart wrung by the appalling death-rate among the patients, and he resolved to find the cause of the scourge which decimated the hospital. Broadly, the facts were these: the mortality among women delivered in the hospital, always higher than that among those confined at home, suddenly rose to an unprecedented figure in the year 1822, when the anatomical basis of instruction was introduced into the curriculum of the medical students. The students used to pass from the dissecting-room to the labour wards, and from this time the hospital mortality rose until at one period nearly half the patients died. The lying-in

hospital consisted of two divisions similar in every respect, except that in the first division the women were attended by the students and in the second division by midwives. Semmelweis found, over a period of five years, that the mortality in the first division remained three times as high as that in the second. What was the cause of this? A significant entry occurs in his note-book:—"All is doubt and difficulty. Only the great number of the dead is an undoubted reality."

In 1847 Semmelweis's friend Prof. Kolletschka died of septicæmia from a scratch on the finger received at a *post-mortem* examination. The circumstances of this tragedy, its origin from the introduction of a poison into a wound surface, the course of the illness, and the pathological results revealed by examination of the body after death brought illumination to Semmelweis. This was a similar condition to the "fever" of puerperal women; both were due to inoculation of putrid organic matter, hence the terrible mortality among women attended by students fresh from the mortuary and the better results obtained by the midwives. In 1847 "the eternally true doctrine" was announced, but no wide publicity was given to it, and it failed to obtain general acceptance. Had Semmelweis been a ready speaker or writer, had his personality been different, more ambitious, perhaps even more winning, the great truth might have been accepted by the profession. Instead of this he died unrecognised, after years of embittering and acrimonious discussion. Sir William Sinclair's book is of the greatest interest, and we are glad to welcome an adequate English appreciation of Semmelweis, who certainly ranks among the "heroes of medicine."

NON-EUCLIDEAN GEOMETRY.

The Elements of Non-Euclidean Geometry. By Dr. J. L. Coolidge. Pp. 292. (Oxford: Clarendon Press, 1909.) Price 15*s.* net.

THIS work will be found really valuable by all students of geometry, especially by those who know little or nothing of the non-Euclidean theories. First of all we have a discussion of the elementary axioms; in this the plane is deduced from what may be called a triangular frame, in the manner of Peano and Schur. Then comes the discrimination of the three cases, according as the sum of the angles of a plane triangle is equal to, greater than, or less than two right angles; and this is followed by the fundamental trigonometric formulæ for a triangle, deduced very neatly from Saccheri's isosceles birectangular quadrilateral. It is also proved at this stage that the non-Euclidean plane can be developed upon a surface of constant curvature in Euclidean space.

The author next proceeds to a discussion of higher spaces (in three dimensions), the absolute, and groups of congruent transformations. The treatment here is entirely analytical, and for the beginner, at any rate, this is doubtless the proper course to take. In fact, most will feel that the analytical treatment of the subject has the great advantage of preserving us from fallacies and vicious circles.

The next chapters contain developments relating to curves and surfaces of the first and second orders; in particular, there is an interesting chapter on the higher line-geometry. In some respects this is analogous to Staudt's representation of an imaginary line of the second kind; but it should be said that there is only a very brief sketch (pp. 127–30) of the interpretation of imaginary coordinates in non-Euclidean space.

The chapter on areas and volumes is remarkably good and clear. The formula for the area of a triangle is obtained by a method which is both elementary and rigorous; and there is a very interesting discussion of the volume of a tetrahedron.

Chapters xv. and xvi. are on differential geometry, and here again the treatment is admirable. For one thing, the quantities usually denoted by D, D′, D″ present themselves in a natural way instead of resulting from a long and tedious calculation. Among the prettiest results of these chapters are the extensions of Meunier's theorem and of Gauss's theorem on the total curvature at any point on a surface.

There is a brief discussion of multiply connected spaces, and two final chapters, each of which is, in fact, an independent presentation of the subject, one from the projective point of view, and the other, like that of Riemann's famous essay, based on the properties of a quadratic differential form. The reader cannot fail to profit from these various ways of regarding the subject; their agreement in results will help to free him from the natural prejudice which many entertain—that non-Euclidean geometry is a mere juggling with symbols, having no relation to the properties of space as it actually is. After the recent critical work on the foundations of geometry, the conclusion is inevitable that there are no grounds at present, and probably never will be, for asserting that the space of physical phenomena is Euclidean or non-Euclidean; while in the realm of speculation the three kinds of space are coordinate, and equally possible.

G. B. M.

COLOUR PHOTOGRAPHY.

Über Farbenphotographie und verwandte naturwissenschaftliche Fragen. By Prof. Otto Wiener. Pp. 88. (Leipzig: J. A. Barth, 1909.) Price 2.40 marks.

THERE is, perhaps, no more remarkable recent scientific achievement than the realisation of the problem of photography in colours, which has occupied the thoughts and aspirations of many workers since the day when Nicéphore Niépce, the founder of photography, told the Marquis de Jouffroy that one day he would reproduce his likeness just as he saw it in a mirror.

In this reprint of a discourse on colour photography and kindred physiological questions, delivered at the Congress of Naturalists in Cologne in September, 1908, Dr. Otto Wiener has given a brief sketch of the principles of the various methods of colour photography, with additions, chiefly of omissions from the discourse itself, together with copious notes and references to the literature, and further details of the

subject, and the biological side of the question as regards colour mimicry in animals. It is illustrated with three plates in colours.

The author first discusses the nature of white light, its decomposition and recomposition, the nature of the colours shown by coloured objects, pigments, dyes, &c., and their effects on the reflection, absorption, and transmission of white light, with special reference to the coloured glasses to be used as filters in three-colour photography. Then the various processes by Ducos du Hauron, Ives, Sanger Shepherd, Joly, Miethe, Lumière, and others for producing coloured photographs by the additive and subtractive methods of colour mixtures, dependent on the theory of triple-colour sensations enounced by Young, Helmholtz, and Clerk Maxwell.

The discussion of the Becquerel and Lippmann direct methods of colour photography, founded on Zenker's theory (1868) of interference and stationary waves producing an alteration of the structure of the sensitive film by reflection, corresponding to the wavelength of the light acting on it, is interesting, because of the author's confirmation of the theory in 1890, and its practical adaptation by Lippmann in 1891. The other direct methods, dependent on changes of colour in sensitive films of silver chloride and subchloride, discovered by Seebeck and worked out by Becquerel, Poitevin, and Niépce de St. Victor, also the "bleach-out" methods of Worel, Neuhauss, Smith, and others are explained. After a short notice of the theories of colour perception, the discourse concludes with some very interesting remarks regarding the protective colour adaptation of animals, and the researches of Poulton, Standfüss, Weismann, Herbert Spencer, and others, illustrated by a coloured plate showing protective mimicry in insects.

Though the subject is dealt with briefly and theoretically, the book will be useful as a summary of results already achieved, and particularly for the literary and other information given in the notes. We note one omission in the list of books at p. 49—Dr. H. W. Vogel's "Die Photographie farbige Gegenstände," 1885. Those interested will find further information in Prof. Wiener's papers in *Wiedemann's Annalen*, xxxi., 1887, p. 619; xl., 1890, p. 203; lv., 1895, p. 225; and Eder's "Jahrbuch für Photographie," 1896, p. 55. J. W.

OUR BOOK SHELF.

Outlines of Chemistry, with Practical Work. By Dr. H. J. H. Fenton, F.R.S. First part. Pp. xvi+365. (Cambridge: The University Press, 1909.) Price 9*s.* net.

THIS book embodies the substance of a course, or part of a course, of lectures which the author gives to candidates for the Natural Science Tripos at Cambridge. Supplemented in practice by experiments appropriate to the topics of each lecture, it is intended to give the student a lead to the study of standard chemical literature. Mr. Fenton explains the difficulty of the circumstances under which the teaching has to be done, and he appears rather as one who has to comply with an established system than the exponent of a system that he thinks the best, or even very good. No one, of any modesty, who is engaged in teaching chemistry to university students at the present day will be very dogmatic about the details of the course that should be followed. The subject has become so vast and so varied that personal predilections and capacities may lead to courses very different from one another and yet of no very different merit. Two extremes may be found in the tendency of one kind of teacher to produce a chemist well informed about substances and another kind to produce a chemist well informed about principles; the first would ordinarily be the better craftsman, the second the clearer thinker.

The tendency of the Cambridge Tripos system is not unnaturally towards making chemistry as much like physics as possible, and accordingly the Tripos candidates are led to concern themselves with theoretical and physical chemistry to an extent which seriously limits their chances of acquiring that personal familiarity and facility with individual chemical substances which in earlier days was one good outcome of the *régime* of analysis. It leads also to a subordination of chemistry in relation to industrial and practical problems. It is possible that some readjustment might be worth considering, having regard to the increasing importance of the Cambridge school and especially to the influence which Cambridge graduates exercise in the secondary schools.

However this may be, Mr. Fenton, on the lines he had adopted, has written a book that must be rated very highly. It is marked throughout by the lucidity and scientific restraint to which we have been accustomed in all his writings; it is very thorough and comprehensive, and it shows a real grasp of the inwardness of a good many things about which there has been a good deal of loose writing and, presumably, loose thinking. It is a book that may be read with profit by every student of chemistry at some stage of his career—perhaps for most at some late stage, when reviews are so valuable, especially if they are free from special pleading. As an example of the excellent substance and form of the book, the chapters on acids, bases and salts may be specially cited, but there is, in fact, little departure from a high level of exposition throughout the work. It seems very likely that the second volume, which is promised, should the first prove acceptable, will be clearly called for. A. SMITHELLS.

The Kea: a New Zealand Problem. By G. R. Marriner. Pp. 151. (London: Williams and Norgate, 1909.) Price 7*s.* 6*d.* net.

FEW birds have attained to greater notoriety than the New Zealand kea, and every naturalist has long been familiar with the strange story of its sheep-killing propensities. The change of habit which it is supposed to have undergone since the introduction of sheep into New Zealand has formed the subject of much discussion by writers on evolution, but it appears that a great deal of theorising has been based upon a singularly small amount of trustworthy evidence. Serious doubt having been cast upon the generally accepted stories, Mr. G. R. Marriner, the curator of the public museum at Wanganui, set himself the task of collecting all the evidence available and personally investigating the habits of this remarkable bird, and the results of his inquiry have been published in a very valuable and readable book. The case has been fairly tried, and the kea stands condemned on abundant evidence. The executioners have long been at work. They did not think it necessary to wait for the result of the trial, and the large sums of blood-money paid for kea heads must have done a good deal to keep the birds in check, though their haunts in the remote mountain regions of the South Island are often so inaccessible that it may well be doubted whether they will ever be exterminated. Those who

love bird-life better than mutton will probably hope not.

The natural food of this extraordinary parrot consists of fruits, roots, honey, worms, insects, and grubs. It is gifted with an inordinate curiosity, and seems ever ready to experiment and investigate novelties. Mr. Marriner believes that this inquiring spirit is responsible for its predilection for fresh meat; that it first began by experimenting with sheepskins and dead carcases, and later on took to killing on its own account. The idea that the kidneys are its especial tit-bits seems to be based entirely upon the fact that the sheep is generally attacked in their neighbourhood; this, however, is the only part upon which the kea can maintain a footing while the sheep is racing about and trying to throw off its torturer. The cruelty of the whole proceeding is horrible in the extreme, and the annual loss to the run-holders is estimated by the author at 5 per cent. of the flocks. The birds appear to enjoy their sport exceedingly, but they have not yet learnt wisdom, and fall an easy prey to the avenger. When the kea hunter has exhausted his cartridges, he sometimes, we are told, allows the birds to see him disappear behind an overhanging ledge of rock. Their curiosity induces them to try and find out what has become of him, and one by one they walk to the edge and look over, only to be knocked on the head by his stick. If so, why waste cartridges? Perhaps there is not always a suitable rock handy.

The book is brightly written, and contains some good illustrations, and we recommend it to all lovers of nature. Considering its size, however, the price seems to be rather high. A. D.

(1) *How to Study the Stars.* By L. Rudaux; translated by Dr. A. H. Keane. Pp. 360. (London: T. Fisher Unwin, 1909.) Price 5*s.* net.

(2) *How to Identify the Stars.* By Dr. Willis I. Milham. Pp. v+38+plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 3*s.* net.

(1) BOTH the means and methods of observation dealt with in this book are eminently practical, being founded for the greater part on the progressive astronomical equipment of the author and the methods which, in actual use, he has found effective. The needs of the amateur are all along kept in mind. The interested and intelligent user of a pair of opera glasses is led to make for himself apparatus more ambitious. As the possessor of a telescope he is shown practical, and often home-made, mountings for the smaller sizes, while for the amateur of means, to whom a medium-sized equatorial reflector or refractor is possible, the question of a suitable house for his instrument is dealt with. Here the varied experience of the author is called in, the important question of cost not being forgotten.

Part ii. is concerned mainly with methods of observation and results. The study of sun, moon, and planets is undertaken, often with apparatus by no means extravagant, and the kind of results which may be expected are indicated, by reference to the author's own work, and by actual photographs reproduced.

For the purpose of progressively instructing amateur astronomers, the book should prove successful. The translation seems, on the whole, well done, and a readable work has been produced.

(2) The title of this book suggests at once its elementary nature. The appeal both of the text and the charts is to beginners in astronomy. The thirty-eight pages of letterpress deal in a sketchy way with such subjects as the history of the constellations, stellar magnitudes, and colours and methods of study. So many subjects in so few pages obviously precludes any fulness of treatment. The "history" consists chiefly of a list of constellation names, with genitives and meanings, together with the names of their proposers, and the section devoted to "star colours" occupies less than a page. The list of the twenty brightest stars, giving magnitudes and colours, is useful, while the division of the eighty-eight constellations into four distinctive groups should prove helpful in memorising.

Four small charts, showing the stars visible at convenient hours during the various months of the year, and twenty-four constellation tracings are appended.

An excellent feature of the publication is the list, at the end of each section, of books and papers suggested for further study.

The general method followed and material presented is stated to be essentially the same as that used in the course on descriptive astronomy in Williams College. Within its limitations the work is accurate and serviceable, and may be recommended as a convenient epitome of the subject.

Scientific Nutrition Simplified. By Goodwin Brown With a Supplementary Chapter by Dr. J. Sven. Pp. xi+271. (London: William Heinemann, 1909.) Price 2*s.* 6*d.* net.

THIS little book is one of the simple-life series. It puts in popular language the information for the practical application of the principles of nutrition advanced by Mr. Horace Fletcher and Prof. Chittenden. The main principle involved is the reduction of the protein intake to about half the amount usually accepted by physiologists as the normal. In reviews of similar books which the present writer has contributed to NATURE during the last few years, it has been pointed out that the Chittenden *régime* is not free from danger, and it is unnecessary to traverse the same ground again. The general tenor of the present work contrasts very forcibly with the scientific exposition of the subject in the work of Max Rubner recently reviewed (November 4, p. 2). The enthusiast sees only the *pros* and does not pause to consider the *cons.* in a subject which really bristles with difficulties. No one wishes to advocate over-eating, but to preach a doctrine of under-feeding as a permanent and universal practice is a very different thing from the temperance and moderation which is the ideal. The majority of physiologists have condemned the Chittenden diet as insufficient, and those with knowledge are more likely to be correct than the faddists, even if they can count one or two disciples drawn from the scientific world in their ranks.

A great point is made in the present work of Mr. Fletcher's advocacy of thorough mastication. Nobody denies the importance of the saliva and of the process of chewing, but to advocate the supreme importance of the least important of the digestive juices, and to elevate the action of the jaws into what seems to be regarded almost as a religious exercise, is not only unscientific, but ridiculous. W. D. H.

A Barometer Manual for the Use of Seamen; with an Appendix on the Thermometer, Hygrometer, and Hydrometer. Issued by the authority of the Meteorological Committee. Sixth edition, extensively revised. Pp. 67. (London: H.M. Stationery Office, 1909.) Price 3*d.*

ALTHOUGH chiefly intended for the use of seamen, this manual will be found of much service by anyone desirous of obtaining accurate information relating to the use of the barometer, and its connection with weather conditions and storms experienced in all parts of the globe. It is a revised edition of the Barometer Manual prepared by the late Admiral FitzRoy, formerly chief of the Meteorological Department of the Board

of Trade, which was very favourably received. The popularity of the present manual and its immediate precursors has been greatly increased by its adoption by the Board of Trade as a text-book in connection with the examination of masters and mates in the mercantile marine service. It has been prepared under the superintendence of Commander Hepworth, marine superintendent of the Meteorological Office, formerly a keen observer of meteorological phenomena in various oceans. Several new charts have been constructed from the materials in the possession of the meteorological committee, and show, *inter alia*, the mean isobars for the middle months of each quarter, and the pressure and prevailing winds for January and July over the globe, with an interesting discussion of the leading features exhibited.

Cows, Cow-houses, and Milk. By G. Mayall. Pp. xi+102. (London: Baillière, Tindall and Cox, 1909.) Price 2*s.* 6*d.* net.

THE above title covers a lot of ground for a small book of about a hundred pages. Naturally, we expect to find the information much condensed; thus, in the chapter on breeds, little more than a page is given to the premier race, Shorthorns. Again, in feeding cattle and in the variations of milk, we are told, in the one case, a fair ratio is 1 to 6 or 7, and, in another place, ½ lb. to ¾ lb. of good oats is said "to improve fat yield and milk taste." We should have preferred to have seen the starch equivalent and protein in the ration explained in a different way. Breeders, like other people, cannot be expected to agree on all points, and we should wish to have our heifers served long before "at the end of their second year."

The illustrations are very good, and misprints in the reading matter appear to be very few. One may be pointed out on p. 56, concerning the average per cent. of fat in cream, which may be anything from 25 per cent. upwards; also, on p. 63, 40° C. should read 40° F. Of the hygiene and veterinary sections we have nothing but unstinted praise. Everyone interested in this important subject should read "Checking the Spread of Disease." The book can be commended to the improving landowner, the land agent, the dairy farmer, and the short-course student, who requires much information in a limited time.

The Oxford Geographies. (Oxford: Clarendon Press, 1909.) *The Elementary Geography.* By F. D. Herbertson. Vol. II., *In and About our Islands.* Pp. 112. Price 1*s.* Vol. IV., *Asia.* Pp. 128. Price 1*s.* 6*d.* Vol. VII. *The British Isles.* Pp. vi+192. Price 1*s.* 9*d.*

Cambridge County Geographies. Gloucestershire. By Herbert A. Evans. Pp. x+155. *Westmorland.* By Dr. J. E. Marr, F.R.S. Pp. ix+151. (Cambridge: University Press, 1909.) Price 1*s.* 6*d.* each.

THE characteristics of the series of elementary books of geography to which the new volumes under notice belong have been described already in these columns (vol. lxxxii., p. 125). In the three new parts of Mrs. Herbertson's "Elementary Geography," it is satisfactory to find the same simplicity of language, correctness of information, and abundance of well-chosen illustrations which served to make the earlier volumes admirably adapted to the requirements of junior classes.

Both Mr. Evans and Dr. Marr have entered into the spirit of the scheme of the Cambridge County Geographies, and their accounts of Gloucestershire and Westmorland respectively maintain the high standard of the series. Geography is given the same wide interpretation, and the books include a description of the architecture, natural history, and geology of the counties dealt with.

LETTERS TO THE EDITOR.

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

The Atomic Weight of the Radium Emanation.

IN a paper by Mr. A. J. Berry and myself read before the Royal Society on December 9, on the thermal conductivities of gases at very low pressures, we showed that for the heavier monatomic gases, neon and argon, the experimental conductivity agreed (as well as could be expected from the present state of the measurements) with that calculated from the kinetic theory from the number of impacts of the molecules per sq. cm. per second and the molecular heat of the gas, assuming perfect interchange of energy on impact.

This suggests a possible means of obtaining experimental evidence on the much-debated question of the atomic weight of the radium emanation. If a moderate fraction of a gram of radium were available the infinitesimal quantity of the emanation would not be an insuperable difficulty, for at the sufficient pressure of 0·04 mm. the emanation from this quantity would occupy the sufficient volume of 2·2 c.c. The pressure of the emanation could be deduced from existing data by means of γ-ray measurements; but also, with hardly any elaboration of the apparatus, an accurate determination of the volume of the emanation could be obtained. For it may be remarked, without in any way reflecting upon the numerous and careful experiments that have been done on this volume since its first determination six years ago by Sir William Ramsay and myself, the purification of the emanation by ordinary methods appears at the best to be imperfect; whereas to an operator experienced in the use of the calcium method, worked out in this laboratory, no difficulty is to be anticipated.

On the view discussed in our paper, the thermal conductivities of the heavier monatomic gases should be inversely proportional to the square root of their atomic weights, so that the atomic weight of the radium emanation could be compared with those of the heavier argon gases by a novel method. FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow.

Alkali-syenites in Ayrshire.

IT is now well known that a group of basic alkalic rocks of approximately late Carboniferous or early Permian age occurs in central Scotland. Dr. Teall first remarked the teschenitic affinities of some of these rocks in his "British Petrography" (1888). During the recent work of the Geological Survey in central Scotland, many occurrences of teschenite, essexite, and theralite have been recognised by Mr. Bailey and Dr. Flett. In several localities the teschenites pass into picrites of the Inchcolm type. Although the general facies of this group is quite basic, and locally ultra-basic, the presence of acid veins in some of the teschenite intrusions has encouraged the hope that a more acidic phase might be discovered in some of the lesser known intrusive masses of central Scotland, hitherto indiscriminately lumped together as "dolerites."

This hope has been realised by the discovery of a large mass of alkali-syenite at Howford Bridge, near Mauchline. This mass, which is intrusive into the Permian lavas of the central Ayrshire basin, is finely dissected by the river Ayr. It is composed mainly of a peculiar medium-grained rock, consisting of thoroughly idiomorphic felspars, principally anorthoclase, with subordinate albite and orthoclase, a little nepheline, numerous small crystals of ægirine, brown and bluish-green soda-amphiboles (barkevicite and arfvedsonite) in mutual intergrowth, and ilmenite altering to leucoxene. The well-shaped crystals of felspars are loosely crowded together, and the angular spaces between them filled with abundant fresh analcite, which encloses the ægirine and soda-amphibole, as though these had been pushed aside by the crystallisation of the felspars in a thoroughly liquid magma. This rock passes downward

into a teschenite by the incoming of purple titanaugite and basic soda-lime felspars, but the latter rock is penetrated by irregular veins of the analcite-syenite.

This occurrence is interesting, inasmuch as there is only one other occurrence of alkali-syenites in the British area, namely, the borolanite and associated syenites of Sutherlandshire. These, however, are probably of Cambrian age. The Ayrshire occurrences are being investigated by the writer with the aid of a Royal Society grant, and it is hoped that an account of these alkalic rocks will be published in a short time. G. W. TYRRELL.

University of Glasgow, December 9.

Collected Works of Sir William Herschel.

I BEG to direct attention to a pressing need, namely, the publication of the collected works of Sir William Herschel. The investigations of this great man are practically inaccessible to the vast majority of modern astronomers, and the result is that few have any acquaintance with his writings, or know them only second-hand. In my relations with American astronomers I have met no one who has made a close study of Herschel's papers, and in going over them myself have been obliged to obtain them from distant libraries and abstract the contents by laborious processes. I have been equally impressed with the deep insight into the laws of nature which Herschel shows, and the slight extent to which his conclusions and methods are known to modern workers. Surely you will be willing to lend your voice to the praiseworthy task of awakening the British public to a national duty. When writing the life of Herschel for the "Encyclopædia Britannica" thirty years ago, the late Prof. Pritchard directed attention to the necessity of the publication of Herschel's collected works; but meanwhile nothing has been done. Italy has published the collected works of Galileo, Holland the collected works of Huyghens, while France has published the collected works of several of her great mathematicians and astronomers, &c., as those of Lagrange, Laplace, Fourier, Fermat, &c., and now the Swiss, with commendable effort, are trying to publish the vast collected works of Euler.

Herschel's writings are not very voluminous, and probably could be comprised in one large or two moderate sized volumes; and it seems certain that a thousand copies of them could be sold within reasonable time, so that a good publishing house might safely undertake the risk; but in order to give the work a national stamp it would need supervision by an official committee of the Royal Society, or the Royal Astronomical Society, of which Herschel was the first president. T. J. J. SEE.

U.S. Naval Observatory, Mare Island, California, November 20.

An International Map of the World.

I HAVE read with much interest, in NATURE of December 2, the communication by Sir Duncan Johnston. I must, however, confess that two of his propositions tend to damage the very principle of uniformity aimed at by the original idea.

For if, in the preparation of the map of closely populated districts, another scale (in the details) is to be adopted, the general idea conveyed by the map will be misleading.

The same is the case with altitudes. It is necessary to take into consideration the fact that, in all probability, the metre-unit will be adopted throughout the world in the time necessary for the preparation and issuing of the proposed maps. In the meantime, it should be noted on the sheets for foot-countries: 1m.=3 feet.

E. BÁTHORI.

Nagybecskerek, Hungary, December 6.

WITH reference to Dr. Báthori's letter on the article which appeared in NATURE of December 2, on the 1/1,000,000 scale international map, I agree with him to the extent that I am fully impressed with the importance of uniformity so far as it can be attained without detriment to the value of the map, but I consider that in some cases uniformity can only be obtained at too great a price.

Dr. Báthori demurs to my suggestion that the detail shown should not be absolutely uniform throughout the world. I can best illustrate my view that too hard and fast a uniformity should not be insisted on by stating a concrete case. The committee proposes, and I think rightly, to show on the map lines of telegraph and post offices. In sparsely settled countries, for example Rhodesia, such information would be useful, and could easily be shown on the map. In the populous London district such information would be of no value, even if it could be shown, and I think that the practical utility of the map would be increased in this case by some departure from strict uniformity. Other similar cases might be given.

With regard to the other point mentioned by Dr. Báthori I am afraid I cannot agree with him that the metre will be adopted throughout the world, and I certainly hope that the completion of the international map will not be postponed until the metre is generally used. In the past and the present the foot has been and is used as the unit of measurement in the United States of America, in Great Britain and Ireland and its colonies and dependencies; practically all records are in terms of that unit, and it must be many years before this unit can be changed, if it ever is. If the countries named do not exceed in area and population those which have adopted metrical measurements, they are, at any rate, large enough to merit consideration. I see no reason why the altitudes in this very large and populous area should be shown on the map in terms of a unit not generally used by their people, nor, on the other hand, do I see any cause why the large and populous countries which have adopted the metrical system should have their altitudes expressed in feet.

It seems to me that, provided the unit adopted is legibly marked on the map and subject to some give and take where the two systems meet, countries using the foot should have their altitudes expressed in feet, and those using the metre in metres. I do not think this would cause material difficulty. The practical advantages of this course seem to me to justify some departure from rigid uniformity.

DUNCAN A. JOHNSTON.

Eastbourne, December 10.

Positions of Birds' Nests in Hedges.

DURING the autumn and winter of the past three years I have been observing the distribution of birds' nests as regards position in the hedges. In the fields around this village the following facts are noticed. In hedges running north and south (facing east and west), by far the greater number of nests are found to the east of a line through the length of the hedge. In hedges running east and west (facing north and south), very few are on the north side, some in the centre, but most to the south of the line through the length of the hedge. There seems to be a very good reason why this should be the case, but it would not do to state reasons without more evidence. I have not seen this matter noticed in any book or "paper," and it would be interesting to know how the majority of the nests in other parts of the country are placed. The present is a good time for such observations.

J. H. TULL WALSH.

St. Faith's, Norfolk, December 2.

Uranium Ore as a Remedy.

WITH reference to Mr. H. Warth's letter in NATURE of November 11 (p. 38), it may be of interest to record a fact which has come under my notice while engaged in the development of a uranious mine in Turkestan. The ore is oxidised and calcareous, and contains uranium, vanadium, and copper, radium being present in accordance with Prof. Rutherford's formula, which gives the quantity of it in relation to the uranium. The uranium is on the average 3·8 per cent., but in some places reaches the ratio of 30 per cent. and more. Until now the work in the mine has proceeded only in the summer time, and in the winter season the workmen have migrated to the neighbouring coal and copper mines. As I know from the literature of the subject that vanadium and uranium are toxic substances, I instruct the workmen to wash their hands well before going to their dinner and after their work. "We

do this," they say, "but at the same time we know that in actual practice a cut on a hand, which lasts for a long time in a coal mine, here, when powdered by the ore, gets well very quickly."

CHR. ANTOONOVICH.

St. Petersburg, Russia, M. Possadskaya 21,
December 4.

Lunar Rainbow of December 1.

ON Wednesday, December 1, about 11 p.m., we saw here a very fine lunar rainbow. It was a perfect bow in the west, showing on a black sky. At the two ends the colours of the rainbow were to be seen quite plainly, though there was only about half a moon. Had there been a full moon, the sight would have been very fine. The rainbow was visible for about twenty minutes.

RICHENDA CHRISTY.

Orchards, Broomfield, Chelmsford.

THE TERCENTENARY OF THE TELESCOPE.

THE year 1609 is one of the most remarkable epochs in the history of astronomy. In the summer of that year Kepler's book on the motion of Mars was published, in which for the first time the actual orbit of a planet in space was determined, while astronomers had hitherto only been able, with more or less success, to investigate the projection of that orbit on the celestial sphere. In the same year the newly-invented telescope was directed to the heavenly bodies, and enabled mankind to form an idea of their constitution, instead of being, as hitherto, reduced to making wild guesses on this subject. But while many years had to pass before Kepler's work became generally recognised (even Galileo never accepted it), the telescope at once became an indispensable tool to astronomers.

Though many attempts have been made to prove that some of the ancient or mediæval philosophers made use of telescopes, it is now generally acknowledged that the telescope was not known to anyone before the year 1608.[1] On October 2 of that year Johan Lipperhey, a spectacle-maker of Middelburg, submitted to the States General an instrument for seeing at a distance, which he had invented, "as was known to the members of the States," and demanded either a patent for thirty years or an annual pension. The States General desired the inventor to produce a binocular telescope, and when he did that they eventually paid him 900 florins for three instruments of this kind, while the patent was refused on the plea that the invention had already become known to many people. These facts are certain enough, but it is quite possible that Lipperhey may not have been the first to construct telescopes, but that the claims of Zacharias Janssen, another spectacle-maker of Middelburg, may be well founded. It appears that this man had invented a compound microscope in 1590. A story was current early in the seventeenth century that some children, when playing with lenses, had found that a weathercock viewed through two of them appeared much enlarged and turned upside down, and that this led to the invention of the telescope. But a telescope which produces an inverted image must have been the so-called astronomical telescope soon afterwards invented by Kepler, which has a convex eye-lens, and not the Dutch or Galilean telescope with a concave eye-lens of which the modern opera-glass may serve as a specimen. A man who had invented a compound microscope would not be unlikely to possess lenses good enough to produce a fair image of a weathercock, and to have been capable of modifying this accidental discovery by substituting a concave eye-lens to make the image upright. Some person is said to have gone to Middelburg to procure a telescope from the spectacle-maker there, but to have applied, by a mistake, to Lipperhey, who thus first heard of the invention.

Whether Lipperhey or Zacharias Janssen was the first to make telescopes will probably never be settled with absolute certainty, but in any case the first telescopes were undoubtedly made in Middelburg. In the introduction to the catalogue of his library (p. xviii), Libri describes a small tract printed at Lyons and dated November 12, 1608, in which mention is made of "nouvelles lunettes" made by a poor, pious and God-fearing man of "Mildebourg"; and the writer states that "even the stars which ordinarily do not appear to our view and our eyes on account of their smallness and the weakness of our vision may be seen by this instrument." From several other contemporary sources we know that knowledge of the new invention spread very rapidly, so that telescopes were not difficult to procure in the spring of 1609, both in the Netherlands and elsewhere. In December, 1608, the States General sent two telescopes made by Lipperhey to King Henry IV. of France; others were publicly offered for sale in Paris about the end of April, 1609, while the news of the invention had reached Venice in December, 1608, and a specimen of the new instrument was brought to Milan in the following May. The wonderful new toy was so very simple that it is not strange that "there was nobody who did not say he had invented it," as a contemporary writer tells us. Among these was Galileo, who in August, 1609, on the Campanile of San Marco at Venice, exhibited a telescope made with lenses purchased in that city. He claimed to have merely heard that a certain Belgian had presented to Prince Maurice of Nassau a glass by means of which distant objects were seen as clearly as if they were quite near, and that this meagre information sufficed to enable him in a single night to design a telescope. If the information received by Galileo was really as scanty as he says, it is very strange that the man who from it constructed a telescope should shortly afterwards, in his "Sidereus Nuncius," show that he hardly had grasped the most rudimentary notions as to the passage of rays of light through lenses and the formation of images. He would have done better if he had followed the explanation of the effect of convex and concave lenses given by Kepler in his book on optics, published in 1604.[1]

But even if we cannot give Galileo the credit which he demanded of having re-invented the telescope, and though, as we have seen, others before him had pointed a telescope to the stars, he deserves full credit for having at once grasped the great possibilities offered by the instrument, and for having made the first serious attempt to explore the heavens with it. He did not grind the lenses himself, but made use of such as he could purchase. Judging by the very rough sketches of the lunar surface given in his little book "Sidereus Nuncius" (published in March, 1610), his small telescopes, magnifying from three to thirty diameters, cannot have been very good; still, they were sufficient to show that the moon was a body like our earth, having mountains and plains, that the Milky Way really was composed of innumerable stars; and, above all, they enabled him to discover the four satellites of Jupiter in January, 1610. Continuing his work, he detected in the following autumn the phases of Venus and Mars, and about the same time he became greatly puzzled by the peculiar appearance of Saturn, which planet, instead of showing a round

[1] See in particular Thomas Henri Ma tin's paper "Sur des Instruments d'Optique faussement attribués aux Anciens par quelques Savants modernes" in Boncompagni's Bulletino, iv., 1871.

[1] "Opera ed. Fr.sch," i., p. 56.

disc, seemed to be "triple." This continued to be an unsolved riddle for nearly fifty years, until Huygens, by using much improved telescopes, showed that it was caused by a detached flat ring round the planet.

In the meantime, other observers lost no time in taking up the new study of the heavens. Before the end of 1608 Simon Marius, of Anspach, procured a telescope with which he found the satellites of Jupiter one day later than Galileo did. He continued for some years to follow their motions with great perseverance and skill, and produced valuable tables of them in his "Mundus Jovialis," published in 1614. Unfortunately, he roused the jealousy of Galileo, who accused him of plagiarism, an accusation which, up to a few years ago, most historians of science were inclined to consider proved, but which has now been thoroughly disproved by a detailed study of the observations of Marius by Oudemans and Bosscha. Marius was also the first to notice the phases of Mercury and the spurious discs of the fixed stars, which the imperfect telescopes of Galileo had failed to show. Even to the sun was the new instrument directed; Galileo says he saw the sun-spots in the summer of 1610, but he does not seem to have taken any interest in them at first, and did not, as usual, announce the discovery, either openly or through an anagram. Thus Johan Fabricius was the first to publish the discovery of sun-spots early in 1611, though Galileo made up for his hesitation by systematic observations, and by being the first to recognise that the spots are formations at the surface of the sun itself, and not bodies moving round the sun, as Scheiner, the third and most assiduous observer of sun-spots, for a long time maintained.

The Dutch or Galilean telescope did not for long remain the only telescope used by astronomers. Already in 1611 Kepler published his "Dioptrice," in which he clearly showed the effect of combining various lenses and the advantages of the "astronomical telescope," in which a real image of the object is formed by the object-glass at the focus of the latter, which is viewed through a magnifying convex eye-lens. A year or two later Scheiner, and following him Fontana, actually constructed and made use of telescopes of this kind, while the inconvenience of the inverted image produced by them was obviated by the introduction of an additional lens in the "terrestrial telescope" to re-invert the image formed by the object-glass. The importance of the real image, which allows a wire or a wire-cross placed at the focus to be seen through the eye-piece as sharply as, and coinciding with, the image, was recognised about 1640 by William Gascoigne, who applied a telescope to a quadrant for measuring altitudes, an application which had been suggested in 1634 by the French astrologer Morin, who, however, only possessed a Galilean telescope. Outside England Gascoigne's idea probably remained unknown, and it was not until 1667 that Auzout and Picard applied telescopes to measuring instruments, and thereby immensely increased the accuracy attainable in astronomical observations.

The importance of the invention of the telescope for the advancement of astronomy is not to be measured only by the insight it gave into the nature of the heavenly bodies, and the aid it rendered in following their movements more accurately. It also rendered an important service by making the Copernican system appear more natural and reasonable in the eyes of every unprejudiced thinker. Hitherto this system had probably to most people appeared to be nothing but a new way of "saving the phenomena" (to use an expression of the ancients), that is, a new method of calculating the motions of the planets, which anyone might use, whether he believed in the reality of the earth's motion or not. Two circumstances had contributed to give an appearance of unreality to the new system; first, the numerous epicycles which Copernicus had been compelled, like the ancients, to use in his planetary theories (because he did not know the first two of Kepler's laws, and therefore had to confine himself to combinations of circles), and secondly, the spurious preface which, without the knowledge of Copernicus, had been added to his book, in which the system was spoken of as a mere hypothesis which need not be supposed to be true. To assume the earth to be one of the planets was also a difficult thing, so long as absolutely nothing was known about the other planets. As to the moon, the ancients had supposed that it must be a body rather like the earth, and the telescope only confirmed this hypothesis. But adversaries of the Copernican system had always asked how the earth could carry the moon along with it during the annual motion round the sun, or why the moon alone should form an exception to the general rule by moving round a planet instead of round the sun? Now Galileo could point to the undeniable fact that Jupiter, during its orbital motion, carried four satellites or moons along with it. The discovery of the phases of Venus and Mercury deprived opponents of Copernicus of another favourite weapon, for they had been wont to proclaim that if Venus moved round the sun it ought to show phases like the moon. Again, the discovery of sun-spots, objects of a temporary nature, supplied a very striking proof that the Aristotelian doctrine of the immutability of all things celestial would have to be given up. While the analogy between the earth and the planets grew stronger every day, it was also of great importance that the fixed stars in the telescope appeared as mere luminous points, so that the apparent diameters of several minutes attributed to them by all previous observers were proved to have no existence. This put an end to the serious objection raised by Tycho Brahe, the greatest practical astronomer since Hipparchus, that a star having no annual parallax and yet showing a considerable apparent diameter must be incredibly large.

As it were in a twinkling of an eye, the whole aspect of the universe had been changed by the invention of the telescope. That this was felt in some way, even by determined enemies of the idea of the earth's motion, may be seen from the statement made by Clavius, the chronologist, in 1611, that astronomers would have to look out for a system which would agree with the new discoveries, as the old one would not serve them any longer. The question could no longer be, "Do you believe in the earth's motion?" it could now only be whether the arguments in favour of this motion were becoming so irresistible that the safest thing to do for its opponents would be to proclaim the doctrine to be heretical. This was accordingly done little more than seven years after the invention of the telescope. J. L. E. DREYER.

THE YUCHI INDIANS.[1]

ANTHROPOLOGISTS have exaggerated the evolutionary gulf between civilised and uncivilised peoples. The more we learn of the latter the narrower does the gulf appear. A remarkable case in point is that of the Yuchis of Oklahoma, recently studied by Mr. F. G. Speck.

Here we have a people engaged in agriculture and cattle-raising, like their white neighbours, wearing the same European dress, and hardly distinguishable from them except in language and colour. It is actually the fact "that many negroes and some poor whites as well are eager enough to work for the

[1] University of Pennsylvania. Anthropological Publications of the University Museum. Vol. i., No. 1, "Ethnology of the Yuchi Indians." By Frank G. Speck. (Philadelphia: University Museum, 1909.)

Indians on their plantations." Yet this people possesses a perfect set of the primitive ideas and practices illustrated in "The Golden Bough." Totemism, tabu, initiation, exogamy, reincarnation, the couvade, new fire, and the medical practice and food regulations found among the rude Australians—these and other primitive ways flourish here. They are not "survivals," but living realities, forming the warp of the social fabric.

This meeting of old and new may be partially realised by the illustration, here reproduced, of the "new fire" ceremony, which forms part of the New Year festival.

The Yuchis constitute an independent linguistic stock. A hundred years after their incorporation with the Creek Confederacy they left Georgia for the west of the Mississippi, in 1836. They now number about 500, in three "towns," and are "a remarkably strong and healthy set of people."

The clan-system is in use, based on maternal descent and totemism. The members are relatives and descendants of certain pre-existing animals, the *oiaron* of other American tribes. The Bear clan worships and protects the bear, getting bear's meat from the

New Fire Rite. Second Day, Annual Ceremony.

Deer clan, and so on. Above the clan-system is the Society or Class. The entire male population is divided into the Chief Society and the Warrior Society. Above this is the Town or Tribe.

Mr. Speck's careful inquiry brings out several interesting points. Students of ballistics will be glad to know that the principle of "rifling" was used in barbarous ages. It is applied to the feathers of arrows. They are twisted so as to make the arrow revolve in its flight.

An important phase of animistic theory is connected with birth. Until the fourth day the child has not "severed all the bonds which link it with the supernatural." On that day it is fed for the first time, and receives a name. "It is then *no longer a half-spirit, but a real human being*, and belongs to earth." (My italics.)

The origin of the tribe is traced to the Sun, and at the New Year festival the town-square is represented as a rainbow. This festival is a good example of primitive ritual, comprising fasting, various tabus, scarification, the rite of the emetic, totemistic drama, inoculation against evil during the coming year, the kindling of sacred fire, and the ceremonial eating of the new corn.

Mr. Speck's interests are chiefly linguistic, but he has made a valuable contribution to general ethnology. The Pennsylvania University Museum is to be congratulated on its first anthropological publication.

MALARIA AND ITS INFLUENCE ON NATIONAL HISTORY.

WIDESPREAD disease, in the form of plagues and pestilences, has profoundly influenced the course of events, local or national, in various countries. The Biblical narrative contains instances of this, and the black death left its mark on European history; in fact, Dr. Gasquet regards the black death as the most important event of the Middle Ages, and a prime factor in the making of modern England. The presence of disease in a locality may in many ways disturb life and enterprise there. Thus the failure of the early attempts to cut the Panama Canal may in part be attributed to the terrible mortality among the labourers, principally from malignant malarial fevers, and the existence of tsetse-fly disease (which attacks horses, &c.) in wide tracts of country in Africa has rendered the problem of transport and the opening up of such districts a difficult one. Prescott, in his "History of the Conquest of Mexico," though writing without the knowledge we now possess, remarks that we find no mention in the records of any uncommon mortality among the conquerors, Cortes and his companions. Had yellow fever and malaria prevailed in the country as they have done in more recent times, in all probability the Spanish conquest of Mexico would never have been accomplished.

Similarly, the introduction of diseases into districts previously free from them may so disturb the balance that the subsequent history of such districts may be entirely altered. A modern instance of this is the introduction of malaria into Mauritius. Until fifty years ago or thereabouts this disease was unknown in these islands; it was then introduced, probably from India, and has since caused serious loss through sickness, in life and by depreciation in the value of property.

It is but a step from a consideration of specific local instances such as these to the suggestion that the introduction of diseases which have the capacity of spreading widely may modify the characteristics and subsequent history of whole nations. This theme in the case of Greece and Rome has been elaborated by Mr. W. H. S. Jones, who sees in the introduction of malaria into these empires at least one of the important factors which helped their decline and fall.

In his "Malaria and Greek History,"[1] Mr. Jones corrects and develops the theory put forward in a previous work (see NATURE, March 19, 1908, vol. lxxvii., p. 457), that man, in the struggle for existence, has to compete, among other enemies, with disease-producing parasites, that even if he is not exterminated by

[1] "Malaria and Greek History." By W. H. S. Jones. To which is added "The History of Greek Therapeutics and the Malaria Theory." By E. T. Withington. Pp. x+175. (Manchester: University Press, 1909.) Price 5s. net.

the disease-parasite, this may so weaken him that he falls an easy victim to his healthier neighbours.

Mr. Jones believes that malaria played a considerable part in bringing about the decline of the ancient Greeks, that this disease fell like a blight upon many fertile districts of Greece, as it almost certainly did upon Attica in the fifth century B.C.

He considers it is at least doubtful if Greece were malarious in early times. For the truth of the theory, it is not, however, necessary to prove (which is impossible) that malaria did not exist in early Greece. For, as Prof. Ronald Ross has pointed out in a recent paper,[1] even if the anopheline mosquitoes, which convey the disease, are present, provided the number of infected persons are few, the spread of infection would be slight or stationary, and the disease might fail for centuries to make headway. If, however, a number of infected immigrants make their appearance, endemic cases will increase, first slowly, then rapidly, until suddenly a widespread epidemic will occur.

In the first chapter of the book the prevalence of malaria in modern Greece and its effect on the inhabitants are discussed. In the two following chapters the evidence contained in the ancient medical and non-medical writers of the existence of malaria in ancient Greece is critically examined. The author believes that on the whole it is safe to conclude that malaria was not prevalent to any extent in early Greece; there are but two doubtful references to the disease before 500 B.C. As regards Attica, there is evidence to show that from the end of the fifth century B.C. malaria began to be prevalent. The disease is referred to in the plays of Aristophanes, and the Decelean and Peloponnesian wars gave opportunity for its spread, partly by the immigration of infected individuals, partly by the neglect of cultivation and drainage of the land, and the increase of the breeding places of the mosquitoes induced thereby.

The history of Greek medicine after 400 B.C. shows a decline in the scientific treatment of disease, and a growing popularity of the dream oracle, charms, and other superstitions, which has never been adequately explained; but it is suggested that the prevalence of malaria, which cannot be treated without quinine, might explain the growth of such superstitious practices. This theme is the subject of an interesting essay by Dr. E. T. Withington.

The condition of the Greeks before the final triumph of Rome seems to have been lamentable—they displayed want of good faith and lack of courage, they had lost ambition and cared for little but pleasure, and brutality, cruelty and vice of all kinds were rife. This period coincides, according to the evidence collected by Mr. Jones, with that during which malaria spread and became prevalent, and he believes that this decadence of the Greek character may in part at least be ascribed to the ravages of this disease. An amount of evidence is accumulated to show that in a malaria-stricken country the inhabitants lose their vigour and moral sense, and become degraded physically and mentally.

Turning now to the case of Rome, Mr. Jones, in an interesting essay,[2] from which we shall quote, similarly seeks to show that malaria exercised a powerful (though to a great extent uncertain) influence upon Roman history and Roman life.

Cicero (first century B.C.) records that on the Palatine hill there was a shrine and altar dedicated to the goddess Fever. This altar, we may remark, is also mentioned by Epictetus (Dissertations), and Pliny says that it had State recognition (both first century A.D.). Although *febris* may be used to denote any febrile condition, it usually means malaria, and the deification of fever is clear proof that it played no small part in the lives of the Romans. As in the case of Greece, the problem arises, has Italy always suffered from the plague of malaria? Many writers have pointed out that some districts (*e.g.* parts of Etruria and Latium), which are now scarcely habitable, were at one time the homes of great and prosperous peoples.

In the very early period, Rome was marshy, but the land around it well drained, cultivated, and the home of prosperous communities, and there is no reason to suppose that malaria was present. By 500 B.C. malaria was in the peninsula, Sybaris being undoubtedly infected, and by the end of the Republic, Sardinia, Sicily, Etruria, Apulia, Latium, the southern coast-line, and Rome itself were all malarious. While not to be regarded as one of the causes of the downfall of the Roman Empire, malaria, Mr. Jones considers, greatly influenced the course of events, and was a serious factor in the lives of the Romans.

Mr. Jones has developed his arguments in a decidedly convincing manner with a wealth of references to classical and modern authorities, and if he has not completely proved his case, the contents of his book and essay are very suggestive, as well as being most interesting reading.

A word in conclusion. Is it not possible that malaria has also played a part in this England of ours? There is a consensus of opinion that parts of Norfolk were once much more populated than is the case at present, as witness the numbers of large and beautiful churches that still exist. Again, within a radius of about three miles round Newchurch, in Romney Marsh, Kent, there are some ten old churches and ruins of two or three others, many more than are now required for the needs of the district, which is sparsely populated, and the same obtains more or less for the whole of the Marsh, where anopheline mosquitoes are still abundantly present, as the writer has found. Both Norfolk and Romney Marsh were formerly very malarious. Has malaria been one of the factors causing the depopulation of these localities?

R. T. HEWLETT.

[1] Report on the Prevalence of Malaria in Mauritius.

[2] "Dea Febris: a Study of Malaria in Ancient Italy." By W. H. S. Jones. Issued by the Liverpool School of Archæology. Pp. 28. (Liverpool: University Press, 1909.) Price 1s.

STATE AID FOR AGRICULTURAL EDUCATION.[1]

THE annual report on the distribution of grants for agricultural education and research in 1907–8, lately issued, is a notable volume by reason of the excellent discussion of the whole subject by Prof. Middleton, one of the secretaries of the Board. The total amount expended for education was 12,100*l.*, an increase of 550*l.* over the preceding year; the total number of students attending the various institutions was 1313, an increase of 92. The numbers are far from satisfactory in view of the fact that some 10,000 young men probably take up farming each year, whilst a certain proportion of the agricultural students do not go in for it at all, at any rate in England. Why does not the farmer take greater advantage of the opportunities for educating his sons? It is hardly a question of means, for agricultural education is very cheap and scholarships are liberally given; nor is it that the farmers do not know of the existence of the colleges. The real reason, probably, is that the farmer is not satisfied as to the value of agricultural education. Prof. Middleton has drawn up a table

[1] Board of Agriculture and Fisheries. Annual Report on the Distribution of Grants for Agricultural Education and Research in the Year 1907–8. [Cd. 4802.] (1909.) Price 10*d.*

showing for different counties the number of men engaged in agriculture, and the percentage of the "whisky money" spent in agricultural education. It is a remarkable fact that the four counties which spend least, 10*l.* or less per 1000 male agriculturists, are purely agricultural, whilst, on the other hand, those with the smallest agricultural population expend about 150*l.* per 1000 male agriculturists. In spite of all that has been said and written on the subject, Prof. Middleton is driven to conclude that "if we except the organised work connected with the institutions, nothing approaching a system of agricultural instruction exists in England."

No one acquainted with the history of agricultural education in England will be astonished at this conclusion, or at the scepticism of the farmer. The first attempts by the old Science and Art Department to foster agricultural education brought the movement into disrepute. The village schoolmaster was encouraged to read up a small text-book, was examined on his knowledge of the text-book, and was awarded a certificate to the effect that he was competent to teach the "principles of agriculture." So long as he remained in his class-room he was secure, but directly the farmer got hold of him and began asking his advice, he was found out. Nor were later attempts more successful. Things are remembered for long in villages, and the movement has in some counties never recovered from the early errors thus committed, whilst practically everywhere these blunders have constituted a sad legacy which has only been lived down by years of hard work on the part of the institutions. These unpleasant facts are recognised, but are not allowed to paralyse further endeavours, and Prof. Middleton proceeds to sketch out a plan of agricultural education.

In the first instance, the general elementary education in country districts must be such that it arouses the intelligence of the boys and brings them to see the advantage of higher education. A beginning in this direction has already been made. Between the age of fourteen and seventeen the boy should still receive a general education either in secondary schools or at evening schools, according to his circumstances. He will not specialise in agriculture, but will develop what he has already learned, be trained to read intelligently and to observe closely. He may form collections of insects, grasses, minerals, &c., but the subject itself is of less moment than the ability of the teacher to teach it well. The teacher will presumably be allowed great elasticity in framing his time-table. From the age of seventeen to twenty special systematic instruction is to be given at an agricultural college. After he has left and started as a farmer, his education is continued at local classes by itinerant instructors, who could also deal with those who had not been to college.

In principle the scheme is excellent, but its success would depend entirely on the men whose duty it was to carry it through. The British farmer never appreciates the beauty and symmetry of a scheme, but he can appreciate a man. It was largely through ignorance on the part of the officials of this important trait in his character that the earlier efforts failed. Consequently the problem reduces itself to the provision of a sufficient number of suitable instructors. Unfortunately, Prof. Middleton does not tell us how these are to be forthcoming. He knows they do not exist at present, and he also tells us why. If a student is willing to go abroad, his prospects of earning a livelihood are satisfactory, but not if he wishes to remain in England. Thus it happens that the best men studying in our agricultural departments look forward to a career outside England, and move off to India, South Africa, Egypt, or elsewhere at an early opportunity. There is no reserve of good men. A very important reason lies in the way the colleges are managed. Prof. Middleton is probably the first official to discover that the only person on the whole college staff who receives a salary worth aiming at is the principal. No one, unless he possesses other means, can afford to remain in any other post, and when a well-trained man accepts a position on the staff, he stays only until he has picked up the technical part of his subject, and then takes other work elsewhere. Further, as it is not worth the while of a competent assistant to remain on with a view of becoming the head of the department, he accepts the first good place abroad that offers, knowing he will have to go sooner or later. The consequence is that there are not at the colleges any number of promising young men who could be put into responsible posts and trusted to carry out such a scheme as Prof. Middleton recommends.

It is not simply a case of getting a little more money to pay the staff. A farm is always a one-man business, and the farmer cannot understand anything else. The governing body of the agricultural college has the same bias; it recognises the principal, but not the members of the staff, excepting occasionally and collectively.

There are, however, signs of a change. A movement is already on foot, although little or no reference is made to it in the report before us, for affiliating the agricultural colleges to the universities. If, as we hope, the universities rise to their responsibility, they will see to it that the teaching at what is virtually their agricultural department is as good as in any other department, and they will know how to secure this end. Our hope for the future lies not so much in the action of the local committees, or even of the Government boards, helpful though these may be, as in the action of the universities themselves. As soon as they take the problem in hand matters will be righted, and the supply of young men wanted for such a scheme as Prof. Middleton's, and for the posts that are opening up in the British possessions beyond the seas, will soon be forthcoming.

LORD WALSINGHAM'S COLLECTION OF MICRO-LEPIDOPTERA.

IT is not much more than two centuries ago since it was possible in England to regard a taste for collecting insects as presumptive evidence of lunacy; and a century ago Kirby and Spence thought it necessary to reply to the current objections to entomology, which represented it as a trifling pursuit, concerned chiefly with nomenclature, and leading to cruelty.

At a much later period complaint was made in some quarters that none of the trustees of the British Museum was interested in natural history; but for many years past this reproach has not existed, several of the trustees being men of high standing as naturalists, and even specialists in certain groups.

Among the foremost of these eminent specialists is Lord Walsingham, who took up the study of the smaller moths (the micro-lepidoptera) of the world about forty years ago, and devoted himself to the formation of what is now incontestably the finest and most valuable collection of these insects in the world, his lordship having supplemented the large collections made by himself in California, Oregon, South Europe, North Africa, &c., by the purchase of all the most important collections of micro-lepidoptera which came into the market, especially that of Prof. Zeller. In 1901 Lord Walsingham's collection was conveyed to the trustees of the British Museum by deed of gift,

on the understanding that the collection should remain in Lord Walsingham's possession as long as he wished. Now, however, it has been arranged that the collection, consisting at present of about 260,000 specimens, and adding about 45,000 species to the small number (estimated at 4000 species) at present in the British Museum, is to be transferred to the Natural History Museum, South Kensington, early next year. The scientific value of such a collection, containing a very large number of types, can hardly be overestimated. We are glad to learn that the present inadequate staff of the museum is to be increased sufficiently to allow of special attention being given to the collection of micro-lepidoptera. Lord Walsingham has also liberally presented his special library relating to micro-lepidoptera to the museum.

The British Museum has previously benefited largely by Lord Walsingham's liberality. He has presented upwards of 15,000 specimens, including many collected during his tour in California and Oregon in 1870–1. In connection with this journey the museum published in 1879 a work on North American Tortricidæ, forming the fourth volume of the quarto series of "Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum." In this work, which was illustrated by seventeen coloured plates, Lord Walsingham described a large number of new species collected by himself. He also published a small volume on the "Pterophoridæ of California and Oregon," in 1880, illustrated by three coloured plates. Numerous papers containing descriptions of new genera and species of various families of micro-lepidoptera by Lord Walsingham have appeared in various periodicals, especially the Transactions of the Linnean and Zoological Societies, and of the Entomological Society of London (of which his lordship was president in 1889–90), the *Entomologist's Monthly Magazine*, &c.

Lord Walsingham has also presented an interesting collection of British macro-lepidoptera (butterflies and the larger moths), accompanied by specimens of caterpillars, mostly prepared by himself, and about fifty of the cases of British birds in their haunts which form such an attractive series in the Bird Gallery.

In conclusion, we must not omit to record that in addition to these numerous benefactions the museum is indebted to Lord Walsingham for the possession of many large and valuable collections which would not have been obtained except through his interest and assistance.

PROF. HILARY BAUERMAN.

THE world of science, and particularly the mining and metallurgical branches, have suffered a severe loss through the death of Prof. H. Bauerman on December 5 from heart failure, after an illness of nearly three months.

Born in 1833, Bauerman entered in 1851, at the age of eighteen, as the first student at "The Government School of Mines and of Science applied to the Arts" (now known as the Royal School of Mines), where he studied under Lyon Playfair, Andrew Ramsay, and Robert Hunt, and particularly under Percy, of whom he was a favourite student, and later a most intimate friend.

During so long and active a life, and starting under such excellent auspices, it is natural that a man of Bauerman's calibre should have passed through a successful and distinguished career, but only those of his more intimate friends who know the work which he actually performed in addition to the immense amount publicly known can appreciate his services to science, and particularly to its technical applications.

His uncompromising attitude on matters where he believed himself to be right, the misunderstandings caused by the slight deafness which existed during his earlier professional life and continuously increased, and the eccentricities which were part of his personality, and added to his charm, to those who knew him, prevented him from receiving such public honours as were his due. His services as one of the first rank were recognised, however, by the many societies and institutions of which he was a member of council and honorary member, and from which he received so many medals and other marks of appreciation. Among other awards, he received gold medals from the Institution of Civil Engineers, the Institution of Mining and Metallurgy, and the Iron and Steel Institute, to the latter of which he contributed a series of most important papers.

After leaving the School of Mines in 1853, he studied for three years at the Freiburg Mining Academy, and in 1855 was appointed assistant geologist to the Geological Survey of Great Britain.

His first work abroad extended from 1858 to 1863, when, as geologist to the North American Boundary Commission, he gained immense experience in accurate surveying and geological work, and laid the foundation for the careful discrimination and accuracy which characterised all his later work.

From 1864 to 1888, his professional and governmental work took him to most parts of the world except Australasia, and his enthusiasm enabled him to gain a store of information on matters other than those relating to his actual work, which his prodigious memory and peculiar ability to employ his knowledge at the right moment rendered available to all who applied to him for help, or delighted those who listended to his, often apparently discursive, talk on general subjects. As a professional man and adviser on technical matters, he was pre-eminent in certain circles, but as an author and teacher he was perhaps better known. He was lecturer on metallurgy at the Firth College, Sheffield, in 1883, and succeeded Percy as professor of metallurgy at the Ordnance College, Woolwich, from 1888 to 1906, when he retired from public service, though not from active life.

It would be useless to attempt any enumeration of the public and governmental positions which he filled, but it may be mentioned that he was examiner in both mining and metallurgy for a prolonged period to the Science and Art Department, an examiner to the Civil Service Commission for Inspectors of Mines, and an outside examiner of students for the Royal School of Mines of London, and for the Camborne School of Mines. Both these positions, and many others, he occupied until his death.

His services to science and technology can only be slightly touched upon, but are, to some extent, perpetuated in his works on "Descriptive" and "Systematic Mineralogy" and the "Metallurgy of Iron," in Phillips and Bauerman's "Metallurgy," in the many valuable papers which he read before learned and especially technical societies, in the large number of notes, reviews, &c., which he contributed, often without signature, to the Press, and in the reports of juries at most of the important exhibitions.

Few of the international exhibitions have been carried through without his help, either as advisor or juryman, and he was probably the last living man who had contributed to the literature published by the juries at the close of the great 1851 exhibition. He was a member of committee and juror, commonly chairman or president, of the mining or metallurgical section, or both, at most of the British and foreign international exhibitions, and one of his latest contributions consisted in two important papers, read before the Iron and Steel Institute, on metallurgy and iron and steel at the Franco-British Exhibition, 1908.

Through the death of Prof. Bauerman one of the few members of the old school, of which his earliest teacher and greatest friend—Dr. Percy—was a type, has been lost to us; one of the most kindly and sympathetic friends to the younger members of his profession has passed away, and a most intimate companion, mentor, and friend has been lost to the writer. Only those who knew him can realise how great a loss is being experienced by his friends, and by the many councils and committees on which he served, and on which his wide experience of men and things rendered him so valuable.

Bauerman, like most great men, died in harness. Even on the day before his death he was occupied in dictating a review on a scientific work, and a few hours before he passed away peacefully in his sleep he was talking of his past labours and of the future work of the younger generation.

GEORGE T. HOLLOWAY.

THE NATURAL HISTORY MUSEUM.

THE Trustees of the British Museum have sent the subjoined correspondence to the *Times*, through Dr. F. G. Kenyon, director and principal librarian of the museum.

House of Commons, December 3, 1909.

Dear Sir Archibald,—At the meeting of the standing committee of the Trustees of the British Museum held on Saturday last at South Kensington, the letters which recently appeared in the *Times* relative to the connection of the Bloomsbury and South Kensington Departments of the British Museum and the relation of their respective Directors were very fully considered. It was unanimously felt that nobody could throw a clearer light upon the matter than yourself; that nobody's voice would be so well listened to; and that nobody's opinion would carry so much weight as your own, if you could be persuaded to give the benefit of your views on the question to your co-Trustees.

I understand that you have recently had occasion to inquire into this matter; may I venture, therefore, to invite you, as one of the Trustees of the British Museum, to be kind enough to inform your co-Trustees of the opinions which you hold upon the subject-matter in question?

If I might venture to suggest, the points upon which it appears to me desirable that we should be informed are (1) whether the Board of Trustees, acting through its standing committee, is in your judgment the best authority for the government of such an institution as the Natural History Departments of the British Museum, and (2) whether, under the existing statutes and rules, the scientific management of the Natural History Museum suffers any detriment from its association with the museum at Bloomsbury.

The Trustees are anxious to be reassured that the management of the Natural History Departments of the British Museum can be usefully, adequately, and properly carried on under the present system, and feel that, as you have recently had the subject before you, and have made special inquiries into it, your judgment upon it would carry special weight.

I may say that, at the meeting of the Trustees on Saturday, November 27, I was instructed by my colleagues to deal with this matter, and I have therefore the less hesitation in approaching you directly upon it.

I beg to remain, yours faithfully,

JAMES W. LOWTHER.

To Sir A. Geikie, F.R.S., Shepherd's Down, Haslemere.

Shepherd's Down, Haslemere, December 7, 1909.

Dear Mr. Speaker,—In reply to your letter of 3rd inst. I have pleasure in stating, for the information of my co-Trustees of the British Museum, the opinion which I have been led to form on the questions you refer to me. I may say that the agitation on this subject, which has been carried on, fitfully but persistently, in the public Press for many years, supported as it has been by some well-known men of science, created in my mind the impression that there was probably some ground for the complaints that had been brought forward. But not until recently have I had occasion to make a careful investigation of the facts of the case. The result of this inquiry has been to convince me that the agitation has no substantial justification, but has arisen from misapprehension or ignorance, and that if the actual state of the matter had been realised no agitation ought ever to have been started.

The allegation so constantly made that the Director of the Natural History Museum is under much more than the merely nominal control of the Director and Principal Librarian at Bloomsbury is without any real foundation. It has probably been suggested by the fact that, as both establishments are administered by one Board of Trustees, the financial business of the whole institution is entrusted to a single accounting officer. In this obviously convenient and economical arrangement the supervision has been assigned to the Director and Principal Librarian, to whom, by Act of Parliament, every other officer of the British Museum is subordinate. But he has no power whatsoever of interference in the scientific work or management of the Natural History Museum. The duties and responsibilities of the Director of the Natural History Departments at South Kensington, as laid down in the statutes and rules, are precisely the same as those of the Director and Principal Librarian in regard to the various departments at Bloomsbury. Each of these officers is charged with the independent control of the museum and staff over which he presides. Thus the subordination of the one Director to the other is, for all practical purposes, non-existent.

I cannot conceive of a scheme which, under a board of managers, could more fully secure liberty of initiation and action in each of the two establishments. Both Directors are in immediate touch with the Board of Trustees. This board is not a bureau of secretaries and clerks in a Government department, but a body of cultivated gentlemen, full of sympathy with the objects of the great institution committed to them, anxious to promote its interests, and ready at all times to seek the best expert advice in matters which may lie beyond their personal cognisance.

It is, of course, not to be expected that any set of regulations, how carefully soever they may have been framed, will provide for every contingency that can arise from the effects of personal idiosyncrasies. In the conduct of any public institution it must be assumed that the duties assigned to the various officers of the staff will be discharged with courtesy, good feeling, and loyalty to the service. Where, unhappily, these fundamental qualities prove deficient, friction is not unlikely to arise; but any instance of it can be dealt with by the governing authority, and should not imply the necessity for a revision of the statutes, still less for a reorganisation of the institution. After a fairly wide experience, I have no hesitation in asserting that I know of no establishment, either in this or any other country, wherein more favourable conditions have been provided for harmonious and effective cooperation in scientific work than have been devised by the Board of Trustees of the British Museum for the administration of the important departments committed to their care.

I remain, yours very faithfully,

ARCH. GEIKIE.

To the Right Honourable the Speaker of the House of Commons.

NOTES.

WE announce with deep regret that Dr. Ludwig Mond, F.R.S., died on Saturday, December 11, at seventy years of age.

WE regret to see the announcement that Sir Alfred Jones, K.C.M.G., who rendered valuable services to science by the share he took in the foundation and endowment of the Liverpool School of Tropical Medicine, died on December 13, at sixty-four years of age.

MR. W. M. TATTERSALL has been appointed keeper of the Manchester Museum in succession to Dr. W. E. Hoyle.

WE learn from the *Revue scientifique* that a monument is to be erected to the memory of Laplace at Beaumont, in Auge (Calvados), where the illustrious mathematician was born in 1746.

BY the will of Mr. G. Crocker, who left an estate of 6,000,000*l.*, Columbia University will receive a fund estimated at 300,000*l.* for the investigation of cancer.

THE Stockholm correspondent of the *Times* announces that the Nobel prizes for this year have been awarded as follows:—medicine, Prof. T. Kocher, Berne; chemistry, Prof. W. Ostwald, Leipzig; physics, Mr. Marconi and Prof. K. Braun, Strassburg.

THE Rome correspondent of the *Times* states that the second general meeting of the International Institute of Agriculture was held there on December 12, and was fully attended by the foreign delegates, of whom more than one hundred were present.

AT the annual business meeting of the Scottish Meteorological Society, held on December 8, Prof. A. Crum Brown, F.R.S., was elected president in succession to the late Sir Arthur Mitchell, K.C.B.; Sir A. Buchan-Hepburn, Bart., and Mr. J. Mackay Bernard, vice-presidents; Mr. R. T. Omond and Mr. E. M. Wedderburn, honorary secretaries; and Mr. W. B. Wilson, honorary treasurer.

THE selected subject of the essay for the Weber-Parkes prize and medals, to be awarded by the Royal College of Physicians in 1912, is "The Influence of Mixed and Secondary Infections upon Pulmonary Tuberculosis in Man, and the Measures, Preventive and Curative, for dealing with Them." All essays, together with any preparations made in illustration of them, must be transmitted to the registrar of the college during the last week of May, 1912.

ON November 24, exactly fifty years after the publication of the "Origin of Species," a number of biological and medical societies of the Netherlands met in one of the large halls of the Amsterdam Zoological Gardens (Natura Artis Magistra) to commemorate this event and the immense and beneficial influence which Darwinism has continued to exercise on human thought since then. Addresses were delivered by Prof. Hugo de Vries on Darwin's visit to the Galapagos Archipelago, and by Prof. A. A. W. Hubrecht on Darwin and the descent of man. The hall was crowded to overflowing, and lavishly decorated with plants, a bust of Darwin occupying the centre in front of the platform. Altogether, the commemoration was impressive and the enthusiasm spontaneous.

AT the monthly meeting of the governors of the Imperial College of Science and Technology held on December 10, a letter was presented from Dr. Henry T. Bovey, F.R.S., tendering his resignation as rector. It is understood that this step has been taken owing to the condition of Dr. Bovey's health. The resignation, which came as a great surprise, was accepted with the deepest regret, and reference was made to the rector's great devotion to, and keen interest in, the important work which he had so recently undertaken, and to his unfailing courtesy and consideration in his dealings with all. Dr. Bovey was appointed rector in May of last year; and the new institution has derived a great advantage from his organising power and educational experience. The governors will shortly appoint a successor.

THE *Times* of December 9 gives an account of the results of a successful expedition, under MM. Paul Pelliot and Nonette, which has just returned from Central Asia. The mission was equipped by the Comité de l'Asie française, the Ministry of Public Instruction, the Académie des Inscriptions et Belles Lettres, and a number of other societies, aided by private subscribers, the total cost being about 16,000*l.* It has accomplished topographic surveys (by Dr. Vaillant) over a distance of 3000 kilometres, on a route from Andijan, in Russian Turkestan, to Chongchu, on the Peking-Hankau line, across the Taldyk Davan range, where a height of 13,000 feet was attained. The results have been remarkable from the point of view of natural history and anthropology, but the archæological and bibliographical discoveries have surpassed all expectations. At Twen Hwang wooden statues and paintings on silk, alleged to be of date anterior to the eleventh century, were secured, also a whole library, including a Nestorian manuscript, printed records, and records stamped on wood, of the seventh century, most of them unknown in Europe and in China itself. These collections will be added to the Chinese section of the National Library.

A STATEMENT of the progress being made with the preparations for Captain Scott's Antarctic Expedition has been communicated to Reuter's Agency. Dr. Wilson, chief of the scientific staff, will also be the zoologist and artist. It is anticipated that three geologists will accompany the expedition, and that one of these will be Mr. Mackintosh Bell, director of the Geological Survey of New Zealand, who has volunteered his services. Mr. R. Simpson, of the Indian Survey Department, will be the physicist of the expedition. He is now on his way to England from Simla. A second physicist will be taken. There will be two, or possibly three, biologists. With Dr. Wilson will be associated a second medical man, who will study botany and bacteriology, giving particular attention to the investigation of blood parasites. The services of Mr. C. R. Meares, who lately completed a journey on the Chino-Tibetan border, have been secured for the expedition. He will leave England almost at once for eastern Siberia to obtain the ponies and dogs. He will collect the animals at Vladivostok, from which place they will be sent to Kobe and trans-shipped for Australia and New Zealand. Mr. Meares will join the expedition in New Zealand.

WE learn from a report recently issued by the United States Department of State that during the first Pan-American Scientific Congress, held at Santiago, Chile, in January last, the following resolution on the universal time system, based on the Greenwich meridian, was submitted by Prof. David Todd, of Amherst College, U.S.A., and unanimously adopted:—Whereas (1) in the relations between the peoples of the world, diplomatic, commercial, or other, a standard of time is a common and well-recognised benefit to all; and whereas (2) the world standard of universal time, based on the division of the globe into hourly belts reckoned from a common origin, has now been in use with indisputable advantages since November 18, 1883, in certain countries; and whereas (3) practically all the European countries, Egypt, South Africa, India, Burmah, Australia, Japan, New Zealand, Canada, the United States, and other countries, have already adopted this system of universal time; and whereas (4) the necessary time-signals are now sent out daily, with all essential accuracy and without cost, throughout the American continent, by cable or wireless telegraphy: *Be it resolved*, that the first Pan-American Scientific Congress urge upon such Governments as may not already have taken this step the adoption of the universal time system referred to the meridian of Greenwich, to be effective from January 1, 1910. This comprehensive endorsement of world time by

the Latin-American countries forms a fitting recognition of the twenty-fifth anniversary of the inception of a time system which has wrought all the advantages that its originator, Sir Sanford Fleming, foresaw. At the instance of Prof. Todd's representations to these Governments, both Peru and Panama had already adopted standard time officially in 1908.

THE sixty-first meeting of the American Association for the Advancement of Science is to be held in Boston, at the invitation of Harvard University and the Massachusetts Institute of Technology, from Monday, December 27, to January 1, 1910. The president of the meeting will be Dr. David Starr Jordan, of the Leland Stanford Junior University. Addresses of welcome will be delivered by Dean W. C. Sabine for Harvard University and by President R. A. Maclaurin, of the Institute of Technology. The retiring presidents of the sections, with the subjects of their addresses, so far as announced, are as follows:—mathematics and astronomy, Prof. C. J. Keyser, the thesis of modern logistic; social and economic science, Prof. W. G. Sumner; geology and geography, Mr. Willis; zoology, Prof. C. Herrick, the evolution of intelligence and its organs; physics, Prof. K. E. Guthe, some reforms needed in the teaching of physics; botany, Prof. H. M. Richards, the nature of response to chemical stimulation; chemistry, Prof. L. Kahlenberg, the past and future of the study of solutions; physiology and experimental medicine, Prof. W. H. Howell; mechanical science and engineering, Prof. G. F. Swain, the profession of engineering and its relation to the American Association for the Advancement of Science; education, Prof. Dewey, science as a method of thinking and science as information in education; anthropology and psychology, Prof. R. S. Woodworth, racial differences in mental traits. The presidents of sections for the meeting are as follows:—mathematics and astronomy, Prof. E. W. Brown, Yale University; physics, Dr. L. A. Bauer, Carnegie Institution; chemistry, Prof. W. McPherson, Ohio State University; mechanical science and engineering, Mr. J. F. Hayford, U.S. Coast and Geodetic Survey; geology and geography, Mr. R. W. Brock, Canadian Geological Survey; zoology, Prof. W. E. Ritter, University of California; botany, Prof. D. P. Penhallow, McGill University, Montreal; anthropology and psychology, Dr. W. H. Holmes, Bureau of American Ethnology; social and economic science, Mr. B. W. Holt; physiology and experimental medicine, Prof. C. S. Minot, Harvard Medical School; education, Prof. J. E. Russell, Columbia University, New York. A popular lecture will be given during the evening of December 28 by Dr. C. W. Stiles, of the Boston Public Health and Marine Hospital Service, on the hook-worm disease in the south.

WE have to acknowledge the receipt of a copy of an article on Darwin, by Prof. A. A. W. Hubrecht, published in *De Gids*, No. 12; also of one by Dr. Angel Gallardo on "Las Investigaciones Modernas sobre la Hereneia en Biologia," extracted from a volume published at Cordoba to commemorate the retirement of Dr. R. Wernicke from the faculty of medicine. The latter deals largely with the main principles of the Mendelian theory.

CRUSTACEANS form the subject of two articles published in part i. (London: Williams and Norgate) of a report to the Government of Baroda on the marine zoology of Okhamandal, in Kattiawar. In the first of these Messrs. J. Hornell and T. Southwell describe a new species of pea-crab of the genus Pinnoteres infesting window-oysters (Placuna), and remarkable for the number and large size of the males, while in the second Mr. Southwell discusses the anomurous crustaceans of the same area.

THE practical improvement of ethnological collections in provincial museums forms the subject of the chief article in the November number of the *Museums Journal*, the article being an address read by Mr. F. W. Knocker at the Museums' Conference at Maidstone last summer. It is pointed out that valuable objects of this nature preserved in local museums are frequently assigned to countries wholly different from those from which they originally came, and that urgent need exists for intelligent geographical classification of such collections.

To the Transactions of the Edinburgh Field Naturalists' and Microscopical Society for 1908–9 (vol. vi., part ii.) the Rev. D. W. Wilson contributes some interesting notes on birds mentioned in early Scottish literature and documents, from which it is made evident that the crane was formerly common in Scotland, thus adding strength to the opinion of the late Mr. T. Southwell that it formerly bred in East Anglia. In another paper in the same issue Mr. J. C. Adam directs attention to the long nesting-period of the more typical members of the crow-tribe, a fact to which no allusion appears to be made in bird-books. Fourteen days for incubation and another fourteen for the nestlings to acquire their feathers is, for instance, the length of the nesting-period in the case of the thrush. In the case of the rook, on the other hand, the eggs are brooded for seventeen days, and the young require another twenty-seven or thirty days in the nest, making the whole nesting-period nearly seven weeks. The carrion-crow requires an additional week, while the raven seems to take about a week more than that species.

THE need of a regular study of the sequence of plumages in birds forms the subject of an editorial article in the December number of Witherby's *British Birds*. It is pointed out that when a bird first leaves the nest it is either naked or clothed with a down-plumage. The latter is succeeded by a juvenile plumage, acquired by a complete moult. In a few instances this juvenile dress may perhaps be indistinguishable from that of the adult, but in most cases, at any rate, it is generally possible, and often easy, to differentiate between the two. In some instances, when the dress of the adults of the two sexes is different, the juvenile plumage approximates more or less closely to that of the female, but more commonly it is markedly different from that of both adults. It may be spotted or streaked, it may show light borders to the feathers, it may be duller than that of the adult, or may be altogether distinct. It is proposed to institute a careful study of these early plumages of British species, and then of their successive summer and winter liveries season by season.

IN a report on the progress of game-protection in the United States during 1908, published in the Year-book of the Department of Agriculture, Mr. T. S. Palmer states that the year 1908 was not marked by any event of special importance, but a number of factors, at least in certain localities, affected the condition of game and the success of the hunting season. On the whole, the game wintered well, and conditions in the spring were better than normal. During the summer a prolonged drought, accompanied by forest-fires, occurred in several of the northern States, and threatened serious injury to deer and grouse, but the loss proved less than predicted. In the Carolinas and Georgia floods in August and September caused great destruction of deer and wild turkeys. The difficulty of obtaining game-birds for stocking coverts increased interest in the grey partridge of Europe, and resulted in the importation of a much larger number of these birds than in any previous year. The rapidly increasing popularity of the automobile and the motor-boat in the pursuit of game is apparently

affecting the abundance of certain species in some localities, and indicates the necessity for better regulation of such methods of hunting.

IN a recent number of the Proceedings of the Zoological Society of London (October) Dr. F. Wood-Jones gives an abstract of his remarks on the new theory he has formulated on the origin of coral reefs and atolls. According to his view, the presence or absence of sedimentation determines, in the first place, whether the reef corals are not, or are, able to form a reef on a submerged bank. The tendency of reefs, once started, to become "basin-shaped" is due to the sediment that falls and settles on the side of the reef that is protected by the growing corals from the washing action of the sea currents. When the reef reaches the tide limit the waves hammer fragment against fragment and form a quantity of coral débris, which becomes cemented into a solid breccia to form the basis of the coral island. A small coral island once formed in this manner provides an impediment to the current, and the burden of sediment the current carries is deposited in stream lines from its extremities. "In this way the form of the island tends to becomes a crescent." The theory is ingenious and full of interest, but until the full paper, which we may hope will be adequately illustrated, is before us, it is difficult to believe that it will entirely supplant the older theories of "subsidence" or of "solution." Neither the simple and beautiful theory of Darwin nor the more complicated but still fascinating theory of Sir John Murray have received universal support; it is hardly possible that Dr. Wood-Jones's theory of sedimentation will prove to be capable of solving all the difficulties.

THE first appendix to the *Kew Bulletin*, 1910, has been issued. It contains, as usual, the list of seeds of hardy herbaceous plants and of trees and shrubs which have ripened at Kew during the year and are available for exchange with botanic gardens and regular correspondents.

A PAPER of much interest contributed by Dr. Th. Weevers to *Recueil des Travaux botaniques Neerlandais* (vol. vi.) discusses the physiological significance of some glucosides. The author previously studied the glucoside, salicin, present in twigs of *Salix purpurea* as a reserve product, and observed that when the shoots start growing it gives place to a body saligenin, and apparently this in turn to catechol. He now reports the discovery of the enzyme, salicase, which decomposes salicin. Further, he identifies two oxidation ferments, which act upon saligenin and catechol respectively. These and other results lead to the following argument. During the summer salicin is formed in the leaves by day, but is decomposed by night, and the glucose is transported to the cortex; each day the catechol combines with more glucose to form salicin. In the autumn the process ceases, because the cortex contains as much salicin as the leaves. These conclusions agree with the hypothesis that benzene derivatives combine with carbohydrates to form substances which diffuse with difficulty, and that serve to keep the sugar stored in the tissues.

AN essential feature of the scientific investigations undertaken at the Rothamsted Experimental Station is the practical bearing of the problems involved; this is evident in the papers originally published in the *Journal of Agricultural Science* (October), now issued in pamphlet form from the Cambridge University Press. A communication by Drs. E. J. Russell and H. B. Hutchinson deals with the effects produced by partial sterilisation of soils. When a soil is heated to 95° C. or treated with volatile antiseptics, *e.g.* carbon bisulphide, it becomes more productive for a while. The authors find that there is an increase in the production of ammonia, which is due to a rapid increase of bacteria. Reasons are given for believing that the chief factor is the destruction by sterilisation of large competing organisms of the nature of protozoa. If this be so, it is possible that some method may be devised for suppressing these undesirable soil organisms, and the authors state that this practical question is receiving attention. Drs. H. B. Hutchinson and N. H. J. Miller have attacked the problem of nitrogen assimilation by plants to test the evidence in favour of direct absorption of ammonium salts. Experiments were conducted with wheat and peas grown in water and sand cultures under the conditions necessary for excluding nitrifying organisms. The results show that these plants can take up their nitrogen entirely in the form of ammonium sulphate, although wheat thrives better when supplied with a nitrate. It is mentioned that other investigators have found a partiality for ammonium salts in the early stages of a plant's existence, while nitrates have been necessary or more fruitful in later stages.

SOLID carbon dioxide is now being used for refrigeration in the treatment of certain affections of the skin. The substance is obtained in the form of a snow by allowing the gas to escape from a cylinder in which it is compressed. This snow is placed within a tube of metal or vulcanite, and packed by using a solid rod which fits into the tube as a rammer. In this way round or square rods of solid carbon dioxide can be obtained. A rod may be held in the hand with a turn or two of lint intervening, and the free end may be pared to any shape by means of a knife, as it is quite firm. On applying the end of a rod of this kind to the skin with pressure, the frozen surface immediately becomes white and hard. The process of thawing occupies about the same time as the application. Reaction sets in at once, the treated area becoming perceptibly swollen in two or three minutes. A wheal forms within half an hour, and often a blister is produced within an hour, though with short applications this does not occur. An application of thirty seconds or more is followed by scarring. The application is practically painless. The method is chiefly of use in the treatment of capillary nævi of less than 1 inch diameter. The average duration of the application is about forty seconds. "Port-wine mark" is dealt with in this way. Some moles are amenable to this treatment, and it answers well for warts. In the case of warts a longer application is necessary, say one to one and a half minutes, pressure being continued until a narrow zone of healthy tissue is frozen around the base of the wart. Keratoses (horny growths of the skin) are among the diseases amenable to this method of treatment. It is too early to say what will eventually be the scope and limits of the therapeutic utility of this agent, but the method is of interest as an instance of another application of physics to medicine.

IT is well known that in animals such as the vertebrates, which have a closed vascular system, the nutrient function of the blood is exercised upon the tissues through the intermediation of lymph, that is, the fluid part of the blood which leaks through the thin walls of the blood-capillaries. The problem of lymph formation is fraught with interest, and has exercised the attention of many physiologists. The word leakage just employed, however, implies that the main factor in its formation is the mechanical one of filtration, but this is by no means the truth, or at any rate the whole truth. Osmosis is another physical process concerned, and the labours of physical chemists in elucidating the laws of osmosis have been important from the physiological point of view; but, in

addition to physical forces, the physiological or "vital" properties of the living capillary wall have to be taken into account, and the secretory nature of lymph formation was ably insisted upon by the late Prof. Heidenhain. A somewhat similar set of factors has to be reckoned with in the question of urine formation in the kidneys, and different physiologists hold diverse views concerning the relative importance of the physical and physiological factors concerned. Those interested in the latest development of such discussions, mainly in relation to the formation of lymph, will find them ably discussed in a little pamphlet written by Prof. Asher, of Berne, who has devoted much of his research work in this direction. It is entitled "Der physiologische Stoffaustausch zwischen Blut und Geweben," and though published separately it forms part of a larger work which is being written by collaboration under the editorship of Profs. Gaupp and Nagel, called "Sammlung anatomischer und physiologischer Vorträge und Aufsätze" (Jena: G. Fischer).

MISS E. B. VAN DEMAN contributes to the Proceedings of the Carnegie Institution of Washington an elaborate monograph on the Atrium Vestæ at Rome. This building was first discovered in 1883 at the foot of the Palatine Hill in the Forum, and the excavations have been since carried on at intervals. The investigation of the site is particularly difficult, because, owing to successive outbreaks of fire, the building was reconstructed or restored no less than five times from the Republican period down to that of the later Empire. The most interesting point disclosed by the excavations is that the dwelling of the Vestal Virgins, who guarded the sacred fire, was an adjunct to that of the early king and queen. The queen, as materfamilias of the State, supervised the duties of the Vestals. This fact furnishes strong evidence in support of the theory enunciated by Prof. J. G. Frazer, some five-and-twenty years ago, that the Vestals were originally the daughters of the king, and as such were naturally placed in charge of the sacred fire which was kept alight in the house of the king, and on its maintenance the safety of the State was supposed to depend.

THE December number of the *Geographical Journal* contains a second interim report of the committee of the society on progress in the investigation of rivers, by Dr. Aubrey Strahan. The chief work of the year includes observations of flow, temperature and composition of water, and estimations of dissolved and suspended matter, in the rivers Exe and tributaries, the Medway, and the Severn. A number of notes on special points is appended to the report, and Dr. Mill contributes an extremely valuable paper on the rainfall of the Exe Valley.

MR. V. STEFÁNSSON contributes a short paper on northern Alaska in winter to the Bulletin of the American Geographical Society. The author points out that whereas driftwood was formerly abundant along the entire north coast of Alaska, very little now comes ashore anywhere west or south from Point Barrow, showing that this section of the coast depends for its driftwood on the Yukon River, the banks of which have recently been deprived of much of their tree-growth. A few years ago the Eskimos of northern Alaska might have been broadly classified as inlanders and coast people, but now most of the inlanders have moved to the coast, starved out by the disappearance of the caribou, which has been slaughtered indiscriminately for about twenty years.

IN the Journal of the Scottish Meteorological Society for the year 1908 (vol. xv., third series) Mr. A. Watt, secretary to the society, gives a very interesting summary of the development of the exploration of the upper air by means chiefly of kites and unmanned balloons, from the early experiments of Wilson, Archibald, and others in Great Britain, and Espy, Rotch, and others in the United States, until the present time, together with a brief description of the results relating (1) to the general circulation of the atmosphere, and (2) to the temperature conditions at great heights. It is not claimed that anything new is contained in the paper, but it gives historical notes, and references to original discussions that have appeared in our own columns and other journals of a scientific character, which will be very useful to anyone interested in this important subject. The author thinks that these researches are "perhaps the most brilliant chapter in the history of meteorology."

IN the *Physikalische Zeitschrift* for November 22 Dr. T. Wulf directs attention to the advantages of using calcium carbide as a drying material in electrostatic instruments the insulation of which is to be maintained. He has found that a small piece of the substance will keep the interior of an electroscope he uses for measuring the γ rays from radio-active materials quite dry for several weeks, although the instrument stands in the open exposed to rain. The active surface of the material is kept free owing to the dry powder due to its action falling from the surface as it is formed. The efficiency of the carbide seems to be rather better than that of sodium.

MISS LAURA L. BRANT, of the Brown University, Providence, gives in the November number of the *Physical Review* the results of her re-measurement of the magnetic and electrical properties of a score of steel rods which were made glass-hard and then tested by Prof. Barus in 1885. They were again tested by him in 1888 and in 1897, so that we now have a record of the change of the properties of this steel when kept at ordinary temperatures for twenty-four years. In all cases there has been a diminution of the electrical resistivity of the steel of about 20 per cent. in the twenty-four years, the change having taken place along an exponential curve. The same result would have been reached in three hours if the rods had been heated to 100° C. Miss Brant concludes that glass-hard steel will, if kept at ordinary temperatures, be completely softened in 250 years.

MR. E. MERCK, 16 Jewry Street, E.C., has issued his annual report of recent advances in pharmaceutical chemistry and therapeutics for 1908, vol. xxii., dated from Darmstadt, August, 1909. The present volume has grown to nearly 400 pages, the index of authors alone covering thirty columns, and including more than 1000 names. A hundred pages are devoted to a monograph on organotherapy and organotherapeutic preparations, the remainder of the report being occupied with detailed notes on preparations and drugs, these being arranged in alphabetical order for convenience of reference.

MR. L. OERTLING has sent us a copy of his new illustrated catalogue of assay, chemical, and bullion balances. More than fifty balances are illustrated, ranging from a bullion balance constructed to carry 10,000 oz. and turn with 10 grains, to an assay balance carrying 1 gram and weighing to 0·005 milligram. Among the new balances not previously shown is the ampere balance made for the National Physical Laboratory, weighing to a milligram when loaded with 5 kilograms in each pan. In the case of the weights, it would be desirable to indicate the accuracy of adjustment, if only as explaining the apparent anomaly, a set of weights ranging from 50 grams to 1 milligram being quoted at 2*l.* 5*s.* on p. 59 and at 15*s.* on p. 61.

MESSRS. GALLENKAMP AND CO., LTD., have favoured us with a copy of their catalogue of spectroscopes, spectrometers, vacuum tubes, induction coils, and other accessories essential to modern spectroscopical research. After examining the publication carefully we recommend all who are engaged or interested in such work to acquire a copy, for it is plentifully illustrated, the instruments are described in detail, and instructions are given as to how they should be set up for the best use in various researches. The accessories for the production of spectra, such as tubes, burners, coils, and cells, are very numerous, and the firm makes a speciality of vacuum tubes to which we have previously directed attention (vol. lxxi., p. 448). The "C" type of tube, in which the illuminated gas is viewed end on in a capillary tube, without the interference of the electrodes, is now made in Uviol glass and with ground-in quartz windows, so that investigations of the ultra-violet part of the spectrum may be carried out with the various ultra-violet spectrographs figured and described in the catalogue.

SOME results of trials of the new transmission gear for marine turbines constructed for Mr. George Westinghouse to the designs of Rear-Admiral George W. Melville and Mr. John H. Macalpine appear in *Engineering* for December 3. In this gear the reduction of speed from 5 to 1 is attained by the use of double helical spur wheels and pinions mounted in such a manner as to secure an even distribution of the bearing pressure between the teeth. The full load to be transmitted is 6000 horse-power at 1500 revolutions of the pinion shaft, and a special hydraulic brake was employed in the tests to take up the load. A few of the results are given in the following table :—

B.H.P. delivered by gear ...	3712	4156	4576	5036	5486	5927
B.H.P. of turbine	3771	4197	4623	5138	5567	6057
Efficiency, per cent.	98·7	99	98·9	98·7	98·5	98·7

This efficiency is very remarkable, being as good as has been recorded with the best cut gears of ordinary dimensions. An endurance test of the gear at full load has also been carried out, extending from 3.15 on Saturday afternoon until 7.15 the next Monday morning. During the last thirty-four hours of the run the temperature of the gear remained constant, and there was every indication that the trial could have been extended indefinitely. The performances of this gear on board ship will be looked for with interest, both as regards the working of the gear and the anticipated economy which will result by running both turbine and propeller at their best speeds.

THE conditions of award of the prize of 1000*l.* offered by Mr. Alexander for a British-built aëronautical engine have now been issued. We extract the essential conditions from *Engineering*, as follows. The engine must develop not less than 35 brake-horse-power, and not exceed 245 lb. weight; that is, 7 lb. per horse-power, including all parts necessary for running, cooling apparatus, and accessories. Arms suitable for bolting down to a testing bed are included in the weight, and such arms must be arranged so that the motor-shaft is not less than 16·13 inches above the test-bed. The points on which the award will be given are :—(*a*) weight and petrol consumption; (*b*) trustworthiness and steadiness of running; (*c*) wear of working parts; (*d*) security against fire; (*e*) air-resistance offered by motor. Each motor will be tested on a 24-hours' run, and if the stoppages during this time exceed three, or if the total time of stoppage exceeds thirty minutes, the motor will be disqualified. The balancing will be taken into consideration, and the engine will also be tested at an inclination of 15 degrees, first one way and then the other, an hour's run each way being given. A thrust of 175 lb. will be applied during the tests to represent the thrust of the propeller. The tests will be made in an air current of thirty miles per hour. The regulations comprise subsidiary details, but the above are the essentials. The tests will be carried out at the National Physical Laboratory under the sole control of the advisory committee, and entries may be made not earlier than February 1 and not later than April 30 on entry forms which may be obtained from the secretary, advisory committee for aëronautics, Bushy House, Teddington.

MESSRS. LONGMANS, GREEN AND CO. have published a seventh edition of Prof. W. D. Halliburton's "Essentials of Chemical Physiology for the Use of Students." Scarcely a page of the book has escaped revision, and a new lesson on some typical organic compounds has been included in the book.

A THIRD edition of the "Elementary Treatise on Electricity and Magnetism," by Prof. G. Carey Foster, F.R.S., and Prof. A. W. Porter, has been published by Messrs. Longmans, Green and Co. The whole book has been revised, and many additions have been made. The final chapter has been re-written, and provides a good summary of recent progress in electrical science.

MR. M. KANADE, Baroda, India, has sent us a copy of a list of books he has compiled and classified according to the system, known as the decimal classification and relative index, devised by Mr. M. Dewey, director of the New York State Library. The catalogue does not make it quite clear how the books chosen for classification have been selected, but the scheme provided for the classification of the works in any library should prove useful.

OUR ASTRONOMICAL COLUMN.

DANIEL'S COMET, 1909*e*.—A second observation by Prof. Daniel of the comet discovered by him on December 6 is reported by a telegram from the Kiel Centralstelle, and the following elements and ephemeris, computed by Dr. Ebell from observations made at Princeton (December 7), Northampton (December 8), and Nice (December 9), are published in Circular No. 116 from the Kiel Centralstelle :—

Elements.

$T = 1909$, December 5·6011 (Berlin).
$\omega = 8^\circ\ 16'\cdot42'$
$\Omega = 73^\circ\ 33'\cdot08'$ } 1909·0
$i = 26\ \ 56'\cdot90'$
$\log q = 0\cdot19674$

Ephemeris 12h. (M.T. Berlin).

1909	α h. m.	δ ° ′	log Δ	Brightness
Dec. 13 ...	6 18·1 ...	+39 31·0 ...	9·789 ...	0·99
15 ...	6 18·4 ...	+41 6·2		
17 ...	6 18·7 ...	+42 38·8 ...	9·794 ...	0·96
19 ...	6 18·9 ...	+44 8·4		
21 ...	6 19·0 ...	+45 34·7 ...	9·802 ...	0·92

As the comet is travelling northwards through Auriga, nearly parallel to the line joining θ and β Aurigæ, it will probably remain observable in the northern hemisphere for some time.

The above elements show a likeness to those of comet 1867 I., but are, as yet, too uncertain to permit of any definite conclusions.

It will be seen from the ephemeris that the comet is now receding from the sun, and is becoming fainter; the unit brightness, at time of discovery, was given as 11·0.

HALLEY'S COMET, 1909*c*.—A further ephemeris for Halley's comet, based on the assumption that perihelion passage will take place at 1910 April 19·67, is published in No. 416 of the *Observatory* (December, p. 476), and extends to April 5·1 (Berlin Time). In the interval the comet will pass from Taurus, through Aries, graze the

northern limit of Cetus, and traverse Pisces. The short time that the orbit plane of the comet lies above the plane of the ecliptic is shown by the fact that the ascending and descending nodes are passed on January 17·9 and May 18·6, 1910, respectively; on the latter date the comet transits the sun. For seventy-eight days it remains inside the earth's orbit, being at unit distance from the sun on March 11·6 and May 28·7 respectively. At the beginning of March the comet will set about three hours after the sun, and will probably be unobservable from the end of the first week until nearly the end of April; then it will become observable before sunrise.

Numerous visual observations are now being recorded. Among others, Prof. Schorr reports that Dr. Graff saw the comet, with the 9½-inch equatorial of the Hamburg Observatory, on November 18, as an elongated nebulous mass, whilst Herr H. Thiele saw it with a 4½-inch comet-seeker. A number of observations are also reported in No. 4373 of the *Astronomische Nachrichten*. According to a *Daily Mail* correspondent, the Greenwich photographs show curious fluctuations of brightness. On November 22 the comet was of the tenth magnitude, whilst on November 30 it was of the twelfth, although on December 1 it was again brighter.

MARS.—In the December number of the *Observatory* the Rev. T. E. R. Phillips briefly reviews the various observations which have been made of the Martian features during the present opposition. His own observations indicate that the polar cap was not symmetrical about the pole of rotation, but was further from the south limb when the central meridian lay between longitudes 300° and 50° than when the other side was presented. The canals, generally, have not been well seen by Mr. Phillips, and only the Euphrates has been seen duplicated. He also refers to the lack of brightness in the white regions so well seen in 1903. Six drawings of the planet, by Mr. Phillips, accompany the note, and illustrate the various points to which the author refers.

OBSERVATIONS OF JUPITER.—In No. 4372 of the *Astronomische Nachrichten* Herren H. E. Lau and C. Luplau-Jannsen describe their observations of Jupiter made during the period January–May of this year. Numerous spots were seen in the different bands, the activity of the southern hemisphere in this respect during the recent oppositions apparently exceeding that of the northern. Band iv. appeared redder than hitherto, and the bright central line more irregular. In April a remarkable projection was seen on the southern edge of band v., darker than the band itself, but apparently partaking of the general motion of that region. Important changes took place in the visibility and form of the Great Red Spot between the end of January and the end of March, and on March 28 the spot itself could not be seen, although its place was partially occupied by a bright egg-shaped mass. A discussion of these changes and a number of measures of the various features also form part of the paper.

In No. 4373 of the same journal Dr. H. H. Kritzinger asks that all those observers who have unpublished measures of the position of the Red Spot will kindly communicate the same to him at 7, Hindersinstrasse, Berlin N.W.

A SOLAR PHYSICS OBSERVATORY FOR AUSTRALIA.—The importance to solar physics of the installation of a properly equipped observatory in Australia can scarcely be overestimated, and it is therefore with great pleasure that we learn, from the *Observatory*, that the labours of Dr. Duffield and others in this direction are likely ultimately to become fruitful.

At a meeting held on October 26 a number of prominent Australian officials discussed the matter, and His Excellency the Governor-General, Lord Dudley, in a carefully reasoned speech, pointed out the urgent necessity for the establishment of such an institution. He pointed out that a capital expenditure of at least 10,000*l*., and an annual expenditure of about 1500*l*., would be necessary, but if Australia is to use the exceptional advantages of position and climate which it possesses, and to take her place among the other nations in the progress of science, this opportunity should not be neglected. After discussing the matter at length, the meeting agreed to the following motion:—"That the establishment of a solar observatory is desirable, and that the Federal Government be strongly urged to assume the responsibility of carrying it into effect." Already some 1000*l*. has been raised among private donors, and it has been officially suggested that the Commonwealth Government will materially help the fund, and, in the event of the effort being successful, provide for the maintenance of the observatory. From the opinions expressed by several influential Australian papers it appears very probable that this much needed institution will ere long become established.

THE HAMBURG OBSERVATORY.—We have received from the director, Prof. Schorr, the reports of the Hamburg Observatory for the years 1907 and 1908. In the latter is an account of the removal of the observatory to Bergesdorf and of the new instruments installed therein.

EPHEMERIDES FOR PERRINE'S AND WINNECKE'S COMETS, 1909*b* AND 1909*d*.—Ephemerides for comets 1909*b* and 1909*d* are published in No. 4374 of the *Astronomische Nachrichten* by Dr. Ebell and Prof. Hillebrand respectively. As both these objects are faint, and south of the equator, it is not worth while reproducing the ephemerides here.

A CONTRIBUTION TO APPLIED BOTANY.[1]

OWING, it seems, to the dilatoriness of some of the contributors, the annual report of the German Society of Applied Botany for 1908 has only lately appeared. The society, now numbering 260 members, held its sixth meeting at Strassburg early in August, and ought not to require twelve months for the publication of its report. A curious feature in it is the separation of the account of the discussion of the contents of a paper from the report of the paper itself. It would be more convenient if the two were combined, and the paper followed by the speakers' observations in each case. Thus "Diskussion zur Appel," early in the volume, refers to a paper by Appel at the end.

Wittmack directs attention to the confusion caused by the want of uniformity in the views expressed by experts on botanical matters, affecting especially the German Customs' Department. He recommended the appointment of a technical committee and the publication of its decisions in a special bulletin. This was subsequently found impracticable, and the society decided to utilise its annual report for such purposes as far as possible. As Wittmack's article itself indicates, the expert forces of Germany are so systematised in the various industries that there is little need for a new organisation.

In this report the amusing case of the "everlasting plant," *Selaginella lepidophylla*, is described in detail. Wittmack reported that the plant, as imported for sale as a curio, is dead. Brick, of the Hamburg Plant-protection Station, however, reported that the imported plants are often, as several botanists have shown, living. Any such living plant imported into Germany must pay a tax and be examined for freedom from vine-louse and the St. José scale-insect. Fortunately, common sense prevailed, and the plants are now allowed into Germany as curios.

Mez compares *Merulius lacrymans* with other forms of dry-rot, and shows that it, unlike, *e.g.*, *Polyporus vaporarius*, prepares its way by moistening the timber with the "tears" it produces by its respiration, from the carbohydrates derived from the timber destroyed by it. The practical importance of this is great.

Klebahn describes experiments on the solvent action of root-secretions on "agriculture" and other phosphates. Wittmack defines the term "bulbs" as used horticulturally.

Voigt shows how seriously the contract cereal trade through Hamburg is affected by a correct application of the term "wild oats" in grain analysis, Hamburg and Berlin differing in their interpretation of it.

Muth contributes a comprehensive account of the varied part botany should play in the experimental work of agricultural stations, and shows that neither botany nor botanists occupy their rightful position at present in

[1] Jahresbericht der Vereinigung für angewandte Botanik. Sechster Jahrgang, 1908. Pp. xlii+294. (Berlin: Gebrüder Borntraeger, 1909.)

Germany, especially in comparison with applied chemistry and its followers.

H. Fischer, the discoverer of the symbiosis of N-bacteria with microscopic soil algæ, in a valuable article on soil bacteriology, summarising and discussing the results already obtained, urges the necessity of treating the subject as a botanical one and of encouraging botanists to devote themselves to it if advances commensurate with its practical importance are to be made. Thus at present there is, he states, no known method of bacteriological soil investigation which satisfies the requirements of science and practice. Exclusive of the discovery of the N-fixing power of the bacteria of leguminose roots, little of practical value has so far been ascertained. *Azotobacter chroococcum* is, in passing, quoted as a calcicole plant, thus serving, like some flowering plants, as a soil indicator.

Wieler writes on the smoke nuisance as it affects plant life. He shows how little the subject is understood, urges the creation of a smoke institute for the investigation of smoke problems, and the employment in legal cases of smoke experts as judicial arbitrators. Wieler reviews critically the publications of recent years on smoke, and deals especially with the sulphur compounds on which he has himself worked. The prevention of damage to plant life by smoke is a botanical subject.

P. Sonntag describes the results of his examinations of the ductility and breaking point of the bast fibres of some half-dozen different palms, corrects earlier observations on the subject, and shows the practical bearing of the question, *e.g.*, on the selection of fibres for street sweepers.

Count Arnim, well known for his devotion to the production of new varieties of cereals, contributes a stimulating article on the production of new varieties of potatoes. He contends that hitherto the method pursued has been empirical, the object having been to meet the speculative trade demand for new varieties each year. Scientific men are invited to answer certain questions pressing for solution, and to aid the conscientious practical man in the search for trustworthy starch-producing disease-resisting varieties. Results hitherto obtained in potato-culture experiments are of necessity contradictory, not being based on scientific principles.

L. Bernegau deals with the utilisation of dried potato tubers and of the sweet-potato (batatas) in the German colonies of West Africa. The article is of value to all interested in the industrial application of colonial economic products. Other articles by Bernegau deal with the Togo lemon (*Citrus medica*) and with *Cola acuminata* and *C. vera* seeds.

One of the most important papers in the volume is that by F. Muth on the influence of the nature of the seed-bed on the germination of seeds. Contrary to the opinion prevailing in Germany that, though the nature of the seed-bed is of minor importance, strong filter or blotting paper is the best medium, Muth finds, as a result of many trials of every kind of seed, that blotting paper for most seeds does not provide the best seed-bed. He recommends unglazed white or yellow porcelain dishes. The results of the seed-testing in the Government station in Ireland, of which I have charge (more than 2000 tests being made annually), fully support Muth. Further, we find that for cereals a soil-test, apparently not tried by Muth, gives better results than the porcelain dishes. Brick supplies an illustrated account of the diseases of cocoa, rubber, and other tropical plants of cultivation, and Appel a, now somewhat belated, paper on potato leaf-roll.

The report is one which no one concerned with economic botany should overlook, and reveals the many-sided practical bearings of botany. T. J.

A NEW METHOD IN ANIMAL PSYCHOLOGY.

THOSE who remember the Huxley lecture delivered in 1906 by Prof. Pawlow, in which he complained that the physiology of the sense organs had hitherto suffered from the evil influences of psychology, will turn with interest to a paper entitled "The Method of Pawlow in Animal Psychology," which is contributed to the August number of the *Psychological Bulletin* by Messrs. R. M. Yerkes and S. Morgulis. The method which Prof. Pawlow introduced consists in studying the modifications of the salivary reflex under various mental conditions. By a simple operation a salivary fistula is formed on the outer surface of the cheek of a healthy dog; the wound quickly heals, and the animal suffers no further inconvenience. The flow of saliva under different conditions is studied by collecting it from the fistula and observing its volume and viscidity in given intervals of time. Pawlow calls the salivary reflex "unconditioned" when (as, for instance, on the introduction of food into the mouth) the stimulus naturally and directly calls forth the reflex. On the other hand, a "conditioned" reflex occurs through artificial and indirect causes. Thus, if a sound of constant pitch is produced near the dog on every occasion when food is given, this particular sound (after adequate practice) is sufficient to cause a secretion of saliva in the absence of food. According to Nicolai, the "reflex" thus obtained is a complicated process, the secretion being connected only indirectly with the sound-stimulus by the mediation of the "idea of eating." When once such a conditioned "reflex" has been established, the interest of the experiment consists in seeing to what extent, if at all, the "reflex" is evoked by modifying the stimulus, *e.g.* by varying its pitch, timbre, or loudness, or by including the tone in a chord.

The paper gives a lengthy *résumé* of the study of auditory reactions made in this way by Selionyi, one of Pawlow's pupils. A paper by Orbeli, another of his pupils, also written in Russian, is likewise abstracted in considerable detail. This deals with the visual reactions of the dog. The writer concludes that the "study of conditioned salivary reflexes furnishes no indication that rays of light of different wave-length are received as distinct stimuli by the eye of the dog," although such reflexes "are essentially dependent upon the intensity of the light-stimulus." Nicolai likewise fails to find evidence of colour-vision in the dog. It would, however, be rash to conclude from these experiments that dogs are colour-blind. The dogs mostly used in Pawlow's laboratory were a mixed breed of hunting dogs, and it may well be that in this particular breed colour-differences are very ill attended to. Moreover, it is quite conceivable that when an animal has been trained to salivate, say, to a blue stimulus, a yellow stimulus may also cause salivation, and yet may be clearly distinguished in the dog's consciousness from the blue. This shows the weakness of Pawlow's method and the cautions which are necessary in deducing the mental states of an animal from the study of its salivary secretion. To judge from the list of forty-two papers published (mostly in Russian) by Pawlow and his pupils since 1904, the St. Petersburg school of physiologists has unbounded faith in the possibilities of the method.

THE MESSINA EARTHQUAKE.

THE Messina earthquake of December, 1908, will probably occupy the attention of Italian seismologists for some time to come. In the meantime, Dr. Mario Baratta has published a summary of the results at which he has arrived during an investigation made under the auspices of the Italian Geographical Society. The great shock, he remarks, was not announced by any slight movements in the district chiefly affected. The greater part of this district lies in the Calabrian peninsula, bounded by a line which just includes Palmi, San Procopio, San Stefano, and Pellaro. In Sicily the bounding line includes Faro Superiore, close to the north-eastern corner, and passes a short distance to the west and south of Messina; but, even in this region of maximum devastation, there are small areas within which the buildings appear to have been miraculously preserved.

Excluding Reggio and Messina, where the number of victims is still unknown, the mortality reached a maximum at Cannitello, with a percentage of 42·7; in a few places it ranges from 20 per cent. to 30 per cent., more frequently it lies between 10 per cent. and 20 per cent., while in most places it was less than 10 per cent. Besides the principal meizoseismal area, there are other regions marked by an increase of intensity, such as the well-known zones of Monteleone, La Piana, Ferruzzano, &c., so strongly disturbed in 1905, 1783, and 1907 respectively.

In the chief meizoseismal zone the shock was preceded by a very loud rumbling like the firing of a gun, and the perceptible movement, which occurred in three separate phases, was estimated to last about thirty seconds. The time of the shock within this area is known with considerable accuracy, the clock at the geodynamic observatory of Messina having stopped at 5h. 21m. 30s., or 4h. 21m. 30s. Greenwich mean time. On the Calabrian shores, the sea-waves were greatest at Pellaro, Lazzaro, and Gallico; in Sicily, near Briga, Riposto and Paradiso; they were distinctly perceptible at Malta, and were registered by the tide-gauges at Porto d'Ischia, Naples, Civitavecchia, Porto Corsini, and even in the neighbourhood of Venice.

Dr. Baratta attributes the disastrous results of the recent earthquake chiefly to three causes—the damage resulting from preceding earthquakes, and especially those of 1894, 1905, and 1907; the nature of the rocks on which the houses were built; and the wretched materials used and a system of construction in complete contradiction to the elementary rules that should govern all building in seismic countries. He gives the following scale of foundations, beginning with the worst:—yellow sands, sands and conglomerates in irregular beds, recent alluvia, Miocene sands and conglomerates, limestones and crystalline rocks. The recent earthquake he regards as far inferior in intensity to the first great shock of 1783, which produced permanent changes in the ground and attained a maximum mortality, though occurring in the daytime, of 77 per cent. at Terranova.

PHTHISIS AND INSANITY IN RELATION TO INHERITANCE.

A MEMOIR "On the Inheritance of the Diathesis of Phthisis and Insanity," by Dr. Charles Goring, has been issued by Messrs. Dulau and Co. in the series of Drapers' Company Research Memoirs, emanating from the Department of Applied Mathematics, University College, London. The methods used are similar to those employed by Prof. Pearson in his "First Study of the Statistics of Pulmonary Tuberculosis" and by Mr. Heron in his "First Study of the Statistics of Insanity," but the data are better in one respect, inasmuch as they are based, not on hospital or asylum cases, but upon information obtained respecting the inmates of convict prisons. Whether, however, such a sample can be correctly described as a random sample of the general population, as the author holds, is certainly open to question.

The conclusions reached by Dr. Goring are confirmatory of those previously put forward by Pearson and by Heron; for both phthisis and insanity he finds a very marked correlation between parents and offspring, the coefficients fluctuating round 0·5. In the case of phthisis no evidence is found of infection between husband and wife, the marital correlation being insignificant and negative. When, however, the author states, arguing against the view that the observed correlation between parent and child may be due to infection, that "upon statistical evidence one conclusion alone seems to follow inevitably and may be asserted without reserve. It is that such parental infection, if existent, is relatively inconsiderable, and that almost the whole of the parental association in phthisis represents an inherited predisposition in the child to be infected with the disease of his parents: that the one vital factor in the occurrence of tuberculosis is inheritance," he makes in the last sentence an assertion which it is a little difficult to excuse. To mention only the best known data, he will find in part ii. of each of the last two decennial supplements published by the Registrar-General ample evidence that the mortality from phthisis is five to ten times as great for persons engaged in certain occupations as for persons engaged in others; it is surely idle, with such evidence at hand, to argue that environmental factors are of no importance!

We do not wish to underrate the value of the memoir—the author deserves the thanks of all those interested in the problem for his reduction and discussion of the data—but we think it should be read with caution, as the writer appears insufficiently acquainted with the other evidence bearing on the question. In conclusion, a doubt may be raised whether the most satisfactory method of studying the influence of heredity on phthisis is to deal as a whole with a random sample of the general population. In view of the widely divergent liabilities of different occupations to phthisis, the heterogeneity of the sample may very well unduly increase the correlations observed.

SOME PAPERS ON AMERICAN ZOOLOGY.

THE mammal and bird fauna of Alaska and Yukon territory forms the subject of No. 30 of the "North American Fauna" (U.S. Department of Agriculture). The author, Mr. W. H. Osgood, gives the results of his observations, both on the nature of the country and the fauna, made during three traverses, namely, one through east central Alaska, a second through the Ogilvie Range of the Yukon, and a third along the course of the Macmillan River. The habits, mutual relationships, and range of the different species form the main subject of the biological section, new names being very few. The attention of sportsmen may be directed to certain observations connected with the habits of moose; but, so far as mammals are concerned, the chief interest in this issue is concentrated in the announcement that the pure white bighorn sheep of the Kenai Peninsula, the so-called *Ovis dalli*, passes by imperceptible gradations into the black sheep (*O. stonei*) of the Stikine Valley. For the future these northern wild sheep must be regarded as local races of the Rocky Mountain Bighorn.

Nos. 1701 and 1702 of the Proceedings of the U.S. National Museum are devoted to the description of portions of the collections obtained during the cruise of the *Albatross* in 1906. In the first of these Miss H. Richardson gives an account of the isopod crustaceans collected in the north-west Pacific. In addition to the new Holotelson—a member of the eubranchiate section distinguished by the emargination of the terminal segment of the abdomen—the author describes a very large number of new species, especially in the genus Arcturus.

Fresh-water sponges from the Philippines form the subject of the second paper (No. 1702). The collection was submitted to Dr. Annandale, of the Indian Museum, who refers some of the specimens to *Spongilla philippinensis*, a species described by himself earlier in the present year, and the rest to a new species, *S. microsclerifera*.

In No. 1703 of the same publication Mr. J. P. Moore describes a collection of polychætous annelids dredged last year off the coasts of Labrador, Newfoundland, and Nova Scotia. Most of the specimens came from Labrador, and all are referred to species already known. They serve to confirm the supposition that the Labrador polychætes would prove to belong mainly to Arctic types, with some admixture from a more southern fauna.

STEAM TURBINES.[1]

IN the first lecture it was pointed out that the first practical steam engine was Newcomen's, about the middle of the eighteenth century, and it used about 20 lb. of coal per horse-power hour. James Watt succeeded in reducing this to 5 lb. or 7 lb. of coal per horse-power hour, chiefly through the introduction of the separate condenser, and the Watt engine remained in principle without other than detail improvements until the gradual rise of steam pressure, and consequent extra expansion, caused compound, triple, and finally quadruple expansion engines to be introduced, and as a result the coal bill is now some one-fifteenth of what it was in the time of Newcomen.

It has, however, been found that with reciprocating engines there must be a steam pressure of about 7 lb. per square inch on the low-pressure piston, or otherwise its size and weight become excessive, and also that there is little or no benefit in going to a higher vacuum than about 25″.

With the steam turbine, vacua of 28½″ or 29″, or absolute pressures of from ¾ lb. to ½ lb. per square inch, can be easily utilised, since the difficulty of dealing with large

[1] Abstract of three Cantor lectures delivered before the Royal Society of Arts by Mr. Gerald Stoney, and published in the Journal of the Society for October 8, 15, and 22

volumes of steam does not occur in the case of the steam turbine as in the case of the reciprocating engine, and it has been found that with the steam turbine the gain due to vacuum goes steadily on up to the highest attainable vacua. Between 25″ and 26″, or 26″ and 27″, there is a gain of about 4 per cent.; a further gain of 5 per cent. is made with the vacuum increased to 28″, and a still further gain of 6 per cent. to 7 per cent. when it is increased to 29″.

This is more easily understood if we consider that the theoretical power to be derived from the steam is almost proportional to the logarithm of the expansions, and thus practically the same power can be obtained working from 400 lb. to 1 lb. absolute, or 28″ vacuum, as from 200 lb. to ½ lb., or 29″ vacuum. In each case there are 400 expansions by pressure, and in each case the theoretical consumption of steam by Clausius' cycle would be about 9·3 lb. per kilowatt hour. With 150° F. superheat this would come down to 8·7 lb., and under the conditions of 200 lb. pressure and 29″ vacuum with 150° F. superheat, 13·2 lb. per kilowatt hour has actually been obtained with an overall efficiency, including the alternator, of about 66 per cent., or 71½ per cent. on the turbine shaft, allowing for the electrical losses. Prof. Ewing, in his book on "The Steam Engine," gives a list of principal results obtained from condensing reciprocating engines, and in no case does the ratio of the consumption of steam by Clausius' cycle, compared with that used per indicated horse-power, exceed 64 per cent. As the ratio of brake horse-power to indicated horse-power is never more than 90 per cent., this means an efficiency at the engine shaft of not more than 58 per cent. When it is remembered that the figure obtained in the case of the turbine was 71½ per cent., and further that the reciprocating engine is unable to take advantage of high vacua, it is easily seen where the advantage of the turbine, especially in large sizes, comes in.

The other advantages were dealt with of absence of vibration, reduced cost of repairs and maintenance, and space occupied, this last being only in some cases one-third or one-fourth of that necessary for reciprocating engines.

In very large sizes, also, it has been found practically impossible to make reciprocating engines satisfactory, and it may not, perhaps, be generally known that one of the reasons which led the Cunard committee to adopt turbines for the great express steamers *Lusitania* and *Mauretania* was the fact that the engineering difficulties of the enormous reciprocating engines required made the problem almost impossible of solution without the use of turbines.

Steam turbines may be divided into two great divisions, single and compound. In the former class there is the De Laval, in which the whole of the expansion is carried out in a single jet, but in order to get efficiency the speed of revolution is so high that gearing has to be resorted to, and this limits this type of turbine to small sizes.

The second class is that universally adopted for all large turbines, in which the expansion of the steam is carried out in stages.

The compound turbine naturally divides itself into two subclasses, those in which the expansion of the steam takes place both in the fixed and moving blades, and those in which it takes place in the fixed blades only. Included in the former class is the Parsons, while the latter contains the Rateau, Zoelly, Curtis, and various others. In the Rateau and Zoelly, which strongly resemble one another, the velocity of the steam at each stage is taken up by a single row of blades mounted on a wheel, and in the Curtis by a wheel having two or more rows of moving blades with guide blades between. There are also various combinations of these, especially those with a Curtis high-pressure part and a Parsons low-pressure, but as yet they have not come largely into use.

A description is then given of the various tvpes of turbine, and also the method of calculating the blading and other particulars, along with some practical rules for their design, and it is shown that, with these limitations, turbines can be constructed with similar stresses and dimensions to give outputs varying as the square of their dimensions and inversely as the square of the speed of revolution.

Now it can be shown that alternators also obey the same rule of varying inversely as the square of the speed, and thus it will be seen that alternators coupled to turbines go up in size together, and that, apart from the trouble there is due to being compelled to have an even number of poles, alternators of the maximum size for that speed have similar turbines attached to them, and thus there is no limit to the size of turbo-alternator. In the case, however, of continuous current dynamos, the output of a dynamo (as it is chiefly limited by commutation conditions which depend principally on the ampere turns on the armature per inch diameter) is practically only proportional to the speed, and it is easily seen that a limit is soon reached where the speed of the turbine is too low for economical conditions.

However, by using tandem dynamos it will be seen that the output is doubled, and this enables tandem turbo-dynamos up to about 4000 kilowatts to be economically built.

In the second lecture various applications of and auxiliaries to the steam turbine were described.

The design of condensers has been especially influenced by the introduction of steam turbines. As has been shown, in the old days of reciprocating engines, the condenser giving 25″ vacuum was quite good enough, but nowadays, on account of the great improvement in economy of steam turbines, with higher vacua, it is common to have between 28″ and 29″.

The maximum vacuum which can be obtained from a condenser is the vacuum due to the temperature of the outlet water, and the closer to this we can get the vacuum actually obtained the better. There are two ways of expressing this difference: one is by pressure and the other is by temperature, and for condenser work the latter is the more convenient. When it is remembered that from about 24″ to 27″ each inch of vacuum makes 4 per cent. difference in the steam consumption of a turbine, between 27″ and 28″ about 5 per cent., and from 28″ to 29″ 6 per cent. or 7 per cent., or that, approximately, 3° F. difference in the temperature of the exhaust means an increase or decrease of about 1 per cent. in steam consumption, it is easily understood how important it is to keep the difference of temperature between the outlet water from the condenser and the temperature due to the vacuum as small as possible. This difference in good modern condensers, when condensing, say, 12 lb. per square foot per hour, can be kept as low as 5° F. or 6° F.

Another way of looking at the efficiency of the condenser is the B.T.U. transmitted per square foot of cooling surface per hour per 1° F. difference of temperature, and this figure can in well-constructed condensers be as high as 1000 to 1200 B.T.U.

It is in connection with the extracting of air thoroughly from the condenser that the greatest improvements have been made of late years, and amongst these dry air pumps and the vacuum augmentor are especially prominent. This latter consists simply of a jet of steam drawing the air and vapour from the condenser and delivering it through a small auxiliary condenser to the air pump, and thus, although the air pump may only produce a vacuum of, say, 27″ or 28″, there may be a vacuum of 28″ to 29″ in the condenser, and in practice this appliance has been found most satisfactory. The effect of using this vacuum augmentor has been in some cases to bring up the conductivity from about 250 or 300 to between 800 and 1000, or to reduce the loss of temperature from some 26° F. to 5° F., a gain in temperature of, say, 21° F., or 7 per cent., in the consumption of the turbine.

When it is remembered that the steam jet of the vacuum augmentor only uses about 0·6 per cent. of the steam used by the turbine, it is easily seen that the gain due to the better vacuum is vastly more than the loss due to the steam jet.

One great field for turbines which has only within the last couple of years come into prominence, although it was patented by Mr. Parsons some years ago, is the use of exhaust turbines, that is, turbines taking steam at atmospheric pressure from reciprocating engines or other machinery, and utilising the power contained in it in an exhaust turbine. When it is remembered that there is as much power in steam working from atmospheric pressure down to a 27″ vacuum as between 150 lb. down to atmospheric pressure, it is easily seen that the power of an

existing non-condensing plant can be more than doubled by the simple application of an exhaust steam turbine and condenser. Such installations are now in use all over the country, and from being absolutely a waste product exhaust steam has become a most valuable by-product in many works. In many cases the exhaust steam is intermittent, such as the exhaust steam from a winding engine of a colliery. Such intervals, if not too long, can be bridged over by a thermal accumulator. The principle of thermal storage is itself a comparatively old idea in connection with steam boilers, having been proposed by Druitt Halpin in 1891–2, but the best-known form of accumulator for use in connection with exhaust steam turbines is that of Prof. Rateau, where a tank containing water has the exhaust steam blown through it so that alternately the exhaust steam is partly condensed, and the water in the tank boils, and thus the supply given to the turbine is constant.

In many cases, however, the stops are too long to be bridged over by any form of thermal accumulator, and in such cases what are called "mixed pressure" turbines have been introduced, in which there is a high-pressure part revolving idly when exhaust steam is used, but when the exhaust steam supply fails, by an automatic arrangement this high-pressure part is supplied with live steam, and thus the turbine continues to be driven.

The first applications of the steam turbine to driving machinery were in the driving of electrical machinery, and on land this still continues to be the greatest use for steam turbines, and a full account of turbo-alternators and dynamos is given.

An important development during the past few years has been the application of the steam turbine for driving air compressors. An ordinary steam turbine when driven backwards does not act as an air compressor, but if the blades are suitably shaped it forms a very efficient one, and this fact has led to a large development in the application of steam turbines.

Such turbo-blowing engines are largely used for blast furnaces, the blast pressures required ranging generally from 10 lb. to 16 lb. per square inch.

It may be mentioned that the weight of a turbo-blowing engine complete is 25 tons, and the weight of a reciprocating engine of the same power 430 tons, or seventeen times heavier than the turbine.

For producing pressures higher than 25 lb. per square inch, the design of the blowing engine is usually of the centrifugal type, and consists of a number of centrifugal fans specially constructed to withstand the stresses caused by the high speed of revolution.

In the third lecture an account is given of the greatest development of the steam turbine, that for marine propulsion.

The large and increasing amount of horse-power, and the greater size and speed of the modern engines, tend towards some form which shall be light, capable of perfect balancing, and economical in steam. The marine engine of the piston type does not fulfil these requirements. This led to the well-known *Turbinia* being built, which proved the success of the steam turbine for marine propulsion. After the *Turbinia*, the *Viper* and *Cobra*, torpedo-boat destroyers, followed, but the next great step was the *King Edward*, built in 1902. The arrangement of the turbines was altered considerably from that of the *Turbinia* in order to get increased manœuvring power. Three shafts were still retained, with two screws on the wing shafts and one on the centre shaft, which revolved at rather lower speed; but, instead of all the three turbines being in series, the steam passed first through the centre high-pressure one, and then was divided between two low-pressure turbines, port and starboard. In the same casing as these low-pressure turbines, and at the exhaust end, the stern turbines were incorporated. This gave much better manœuvring power than with the arrangement in the *Turbinia*, as when manœuvring the high-pressure turbine was cut out and steam admitted direct to either or both of the low-pressure turbines or to the astern turbines, thus giving as good manœuvring power as in the case of a twin-screw ship with reciprocating engines.

The success of the *King Edward*, together with that of the *Viper* and *Cobra*, led the Admiralty to have turbines fitted into one of four third-class cruisers, and the vessel chosen was the *Amethyst*. Extensive trials were carried out between her and her sister ship, the *Topaz*, with reciprocating engines, each being 350 feet long and of 3000 tons displacement. The result was that at all speeds above 14 knots the turbine was the more economical, being 15 per cent. better at 18 knots, 31 per cent. better at 20½ knots, and 38 per cent. better at 22·1 knots.

With cross-Channel boats it has been found that the turbine vessels use 25 per cent. less coal per passenger, and travel 2 knots faster, than those with reciprocating engines, and the *Lusitania* has been shown by Sir William White to be 16 per cent. more efficient than the great German reciprocating liners.

The application of the steam turbine to the propulsion of slow-speed ships, that is, ships of below 15 to 18 knots, has up to the present been difficult, owing to the low speed of revolution of the screws making the turbines large and heavy, as well as not economical. This difficulty has now been got over by the use of an arrangement patented by Mr. Parsons some years ago, viz. the combination of reciprocating engines and exhaust turbines, similar to what was described before for land work. Here each utilises the part of the expansion for which it is best suited—the reciprocating engine for the high-pressure part of the range and the turbine for the low-pressure where the volume of steam is large.

It is interesting to note that in the early days of the screw propeller the great difficulty was to make the engines run fast enough for the screw, and spur gearing was adopted in many cases in the first half of the last century. Gearing has been entirely dropped for the last fifty or sixty years, but now the difficulty in many cases is to make the turbine run slow enough for the screw, and once more gearing is being considered so as to make the turbine adaptable for use in slow-speed steamers, which, after all, constitute by far the greater part of the shipping of the world.

The combination system described above does this, but gearing a high-speed turbine to a slow-speed screw would also accomplish what is needed.

Eighty years ago there was nothing but primitive spur gearing, with generally wooden teeth in one member, but now we have steel gears accurately cut by modern machinery, often with helical teeth, and running in oil baths.

At the present date there are about 120 vessels actually on service fitted with turbines, representing about 1,250,000 horse-power, and these comprise practically all the high-speed ships which have been recently built. Some seventy more are under construction, representing another 1,000,000 horse-power, or a total of 2,250,000 horse-power, and the curve of progress as yet shows no sign of saturation.

THE OUTLOOK OF SCIENCE.[1]

PROBABLY there never was a time when the scientific spirit was more active than at the present moment. We see evidence of this on all hands. In the realms of abstract science we have researches dealing with profound questions as to the intimate nature of matter that were not within the sphere of thought only a few years ago. The theories of electrons which are founded on mathematical and physical investigation give us a glimpse into worlds of movement of which those before us had no conception, and of stores of energy that may one day be liberated in the service of mankind. That mysterious agency, electricity, is now seen to be probably at the basis of all phenomena, physical, chemical, vital, and a new interpretation is given of many actions going on all around us. The relation of matter to the circumambient æther also engages the speculations of men of science.

Researches at extremely low temperatures, down near to absolute zero, as carried out by Dewar, are enabling the physicist and chemist to criticise the properties of matter from a new point of view. The microscope, hitherto an instrument used mostly by the biologist, is now employed in the investigation of the molecular structure of metals and other substances, as these are modified

1 From an address delivered to the associates and students of the Glasgow and West of Scotland Technical College on October 28 by Prof. John G. McKendrick, F.R.S.

by pressure and strain. The phenomena of radio-activity have opened up a new world, and no achievement of science is, to my mind, more wonderful than the way in which a modern physicist can measure the velocity and count the number of inconceivably minute particles that fly off from a morsel of radio-active matter.

For many purposes the steam engine has been outdistanced. The energy now available from modern engines is much greater than was at one time thought practicable. The best triple-expansion steam engines gave back as mechanical energy only 17 per cent. or 18 per cent. of the energy represented by the combustion of the fuel, the remaining 82 per cent. and 83 per cent. being lost, or, at all events, is mechanically inefficient, as heat. A human muscle gives as mechanical energy 25 per cent. of the energy of the food, but the remaining 75 per cent. of heat is necessary for the life of the muscle, so that, in this aspect, it is superior to the steam engine.

I have often been struck with the wonderful economy of nature. She attains her ends usually by the simplest and most direct method and with the smallest expenditure of matter and energy, and one cannot help thinking that future inventions—I mean inventions during the next two or three centuries—will be in this direction. The electric organ of an electric eel, at rest, may show so small an electromotive force as to require a good galvanometer to detect it, but a nervous impulse from nerve-cells in its spinal cord may suddenly raise a potential of many volts, and this with little heat and with so small an expenditure of matter as to defy the most expert chemist to weigh it. The electric organ is in no sense a storage battery, but rather a contrivance by which electrical energy is liberated at the moment it is required. The fire-flies, the glow-worms, and many deep-sea fishes can produce light without heat and at a cost which would make the price of a wax vesta an extravagant outlay. Plants, possibly aided by micro-organisms, or at all events by ferments (enzymes), can produce alkaloidal substances at a low temperature and by slow processes; but, on the other hand, to produce these synthetically the organic chemist requires all the resources of his laboratory, high temperatures, acids, and other potent agencies. Many other examples might be given of the economy of nature all establishing the truth that the principle of least action holds good everywhere—a principle which some have thought was a greater, at all events a wider, generalisation than that of the conservation of energy.

There is another department of science to which I must refer in this brief survey. I refer to bacteriology, a branch which deals with the life-history of minute organisms that play a very important part in the economy of nature. In the public mind there is a widespread impression that bacteria and other organisms are the enemies of man, but this is far from being the case with the great majority of these humble plants. Of the thousand or fifteen hundred species now known, probably only fifty or so are inimical to men. The others are highly beneficent. Some are engaged in taking nitrogen from the air for the use of the higher plants: others in splitting up complex substances existing in the bodies of dead plants and of dead animals, and in restoring simpler substances to the soil: others purify our rivers and lakes; even the ocean is the theatre of their activities: and others have to do with the varied phenomena of fermentation. A knowledge of the life-history of these microbes has enabled the physician and surgeon not only to do much in the way of preventive medicine, but to benefit mankind in the treatment of many diseases; and, what is probably of even greater interest, we now recognise that the *rôle* played by these living beings is of the greatest importance in many industries. Such are the industries connected with fermentations, brewing, distilling, baking; the processes of the dairy, as in butter-making and cheese-making; and the important industry of tanning or making leather. In those industries and in scientific agriculture the services of microbes are being more and more called to our aid. Bacteriologists can now make pure cultures of micro-organisms that are useful, and practical men may sow these in approximate media where they do their useful work. In this way the soil of the farmer may be enriched, the growth of particular cereals, leguminous plants, and roots may be facilitated, and the products of the dairy may be made more wholesome. There can be no doubt that in the future many industrial processes, such as these of tanning, paper-making, and others, will be improved as we are able to call these humble beings to our assistance. This, I think, is one of the fairy tales of scientific achievement.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. G. Fearnsides has been appointed demonstrator of petrology, and Mr. F. J. M. Stratton assistant in astrophysics.

Mr. E. M. Wellisch has been elected to the Clerk Maxwell scholarship.

The general board of studies recommends that Mr. K. J. J. Mackenzie be appointed as university lecturer in agriculture for five years, and that he receive a stipend of 200*l.* a year, payable out of the agricultural education fund.

Dr. Stein will deliver a lecture in Cambridge on Thursday, January 20, at 5 p.m., on his explorations in Asia.

LONDON.—A new syllabus in chemistry is to come into force at the matriculation examination on and after January, 1911. In the new syllabus greater emphasis is attached to the theoretical basis of the science and to physical phenomena, such as the development of heat in chemical reaction. The general characteristics of the metals, including an elementary study of sodium, calcium, and iron, and their common compounds, are introduced, while the elementary organic chemistry and a part of what was termed the "chemistry of common life" has been taken out of the syllabus.

OXFORD.—The news of the impending retirement of Dr. E. B. Tylor, F.R.S., professor of anthropology, will be received with universal regret. It is perhaps not easy for the present generation to realise how much the science of anthropology owes to the unwearied labours of Prof. Tylor, continued for the space of full fifty years. The importance which the subject has now attained among the studies of Oxford is in large measure due to the energy and enthusiasm with which, on his appointment in 1883 as keeper of the university museum, and afterwards as reader and professor, Dr. Tylor threw himself into the work of arousing and maintaining interest in the scientific history of the arts and institutions of mankind. Under his careful management, and with the able help of the curator of the splendid Pitt-Rivers collection, Mr. H. Balfour, and of other younger workers, the study of anthropology in Oxford has during the last quarter of a century been completely transformed. Prof. Tylor's kindliness and geniality have secured to him the affection of a large circle of friends, whose good wishes will follow him into his retirement.

THE second annual dinner of the Old Students' Association of the Royal College of Science will be held on Friday, January 7, 1910. Tickets may be obtained from the secretary of the association, Mr. T. L. Humberstone, 3 Selwood Place, South Kensington. Sir Thomas H. Holland, K.C.I.E., F.R.S., has consented to nomination as president of the association for the year 1910, in succession to Mr. H. G. Wells.

SPEAKING at the Strand School, King's College, on December 10, Sir William White said that it is not putting a narrow or improper meaning on the word "education" to say that it must have relation, in the case of the vast majority of men and women, to their getting a livelihood. An examination which is passed by means of cramming is mischievous. In many cases boys crammed for an examination have obtained for themselves positions for which they are totally unfitted. Some men spoil their lives by cramming for examinations; they take away all the freshness of life by simply accumulating different kinds of knowledge for reproduction in a match against time. On the other hand, there are many excellent men who, directly they get into the examination room, can never do themselves justice. Examinations, therefore, do not always find

out the best men; but in the circumstances of the present time it seems impossible to find a substitute.

A REUTER message from Brisbane states that the ceremony of the dedication of Government House buildings as the home of Queensland University was performed on December 10 by Sir W. MacGregor, the Governor of Queensland. Sir W. MacGregor read a message from the King congratulating the people of Queensland and expressing the hope that the enterprise and loyalty which have marked the first fifty years of the existence of Queensland may be an abiding heritage, and that the prosperity of the State will be multiplied abundantly in years to come. The Governor said that he was gratified at participating in a gathering of such importance, establishing as it did the corner-stone of a system of State education. In no other country can the pursuits of professional and economic life be followed to greater advantage than in Queensland, which has an extraordinary multiplicity of resources. The university course includes arts, without unduly encroaching upon more modern developments of direct utility. The plan of the University is an elastic one, and capable of unlimited expansion. Sir W. MacGregor assented, on behalf of the King, to the University Bill, and unveiled a tablet dedicating the building. The gift was accepted on behalf of the people by Mr. Bell, the Speaker of the Legislative Assembly. Speeches were also delivered by Profs. David, of Sydney, and Stirling, of Adelaide Universities. Mr. Kidston announced that 50,000*l.* has been set aside for initial expenditure and 10,000*l.* annually for working expenses, and there will be sixty foundation scholarships.

A RECENT report to the Middlesex Education Committee by its secretary and inspector of schools provides particulars concerning an experiment in operation in Strassburg on employment bureaux for children of school-leaving age. In Strassburg the education authorities work in conjunction with the labour bureaux and the employers. A card is handed to the child on leaving school, which, when filled up, contains all particulars necessary for intending employers. This information is supplied by the parents, the headmaster, and the medical officer. It is obvious that little can be done without the cooperation of employers of labour. Most Strassburg employers now prefer to engage a boy through the bureau, as they are able at a glance to obtain a fair estimate of his capabilities from trustworthy sources, and are in this way safeguarded from employing one who may be unequal to the work required. When a boy is engaged the date is noted, and a record of his career as an employee is kept by the bureau, and this is of great benefit to future employers. The success of this scheme has justified the experiment. Every year a large percentage of children of both sexes find suitable employment in this way. Parents, employers, teachers, and apprentices all speak highly of the scheme. The bureau does not confine its attention to children only, but deals with adults, and is part of a widely spread system, with branches in many parts of Germany as well as in other European countries, and has enabled the authorities to find employment for a large percentage of applicants. The bureau being in direct telephonic communication with every other centre, an applicant is found work in the shortest possible time. With a complete record of a man's career there is little risk of imposture, and no hesitation is made in advancing the railway fare to his work in other towns when necessary.

THE prizes and certificates at the Northampton Polytechnic Institute were distributed on December 10 by Sir John Wolfe-Barry, K.C.B., who in the course of his address spoke of technical education as scientific instruction in the useful arts. It was not, he remarked, until about 1870 that we began to realise that all was not well with the trade of England and with English methods. At that period primary education was at a very low ebb, and scientific education was in the possession of very few. Technical education for the masses was unknown, and was scarcely desired. The late Prince Consort played a prominent part in rousing the country to the necessity of altering its methods and fostering technical education. In 1877 the City and Guilds of London Institute led the way in a systematic manner in developing the new movement. Since they put their hands to the plough they have spent 800,000*l.* of their own property, and are still spending at the rate of from 23,000*l.* to 25,000*l.* a year in developing the movement which they set on foot more than thirty years ago, which has materialised into the Central Technical College at South Kensington, the Finsbury Technical Institute, and their art school at Kennington. Turning to the work of the Northampton Polytechnic Institute, Sir John Wolfe-Barry gave the history of its development from its initiation some fifteen years ago. After referring to the assistance given by the City Parochial Foundation, the Skinners' Company, and the Saddlers' Company, he emphasised the debt which it owes to the London County Council. Dealing specially with the subject of technical optics, he expressed the hope that the much delayed development would be proceeded with before another year had passed, for such development would deal with an important branch of a scientific trade, and a trade in which we ought more than to hold our own with foreign competitors. Returning to the general subject of technical education, he indicated its limitations, and showed how one of its chief objects is to enlarge the army of scientific workers, and thus to enlarge the area from which the leaders and generals of industrial life are to be drawn, tending thus to substitute intelligent methods for the rule of thumb and to make man less and less an animated machine. Technical instruction, he concluded, must follow the abstract sciences, and not attempt to limit them. In the course of the evening the head of the mechanical engineering department, Mr. C. E. Larard, gave a lecture on the twisting of materials to destruction. He directed attention to a remarkable testing machine which has been installed in his department, and embodied in his lecture the results of his researches on the behaviour of various qualities of steel when twisted to destruction. By means of this machine specimens of steel up to 3½ inches in diameter can readily be twisted to destruction.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 1.—Prof. W. J. Sollas, F.R.S., president, in the chair.—W. G. **Fearnsides**: The Tremadoc slates and associated rocks of south-east Carnarvonshire. Results obtained in making a detailed map of the country about Portmadoc, Tremadoc, and Criccieth in Carnarvonshire, and a description of the stratigraphy of the Cambrian and Ordovician rocks there exposed. The sedimentary series are described in the order of their formation. The succession is tabulated. The folding, cleavage, faulting, and jointing of the rocks are described, and an attempt is made to show some relationship between the stress-phenomena which have produced these structures. The great fault through Penmorfa is interpreted as a thrust-plane hading gently to the north-east. It is supposed to form the lowest sole of the group of thrust-planes which follow the southern margin of the Snowdonian mountain-tract. The well-known pisolitic iron ore of Tremadoc is shown to follow the line of this fault. Direct evidence of overthrusting has been got from a study of the graptolite-bearing Llandeilo rocks of Tyddyndicwm, which have been exposed in two artificial trenches dug for the purpose, and the distribution of the andesitic volcanic series in lines of detached lenticles among the Grey Slates is described as evidence of a similar re-duplication of the newer rock-series of the north-eastern district on a more extended scale. It is noted that the dolerites are (1) unaffected by cleavage and faulting, and (2) have metamorphosed rocks which were already cleaved, cut, and re-duplicated by the thrust-faulting at the time of their intrusion. The Glacial and post-Glacial accumulations are also described in outline.—E. S. **Cobbold**: Some small trilobites from the Cambrian rocks of Comley (Shropshire). Most of the trilobites were obtained during the progress of the excavations referred to in the report of the Geological Excavations Committee of the British Association, read at the Dublin meeting, 1908. The specimens were derived from the Olenellus Limestone of Comley, and from the Grey Limestones which intervene between that horizon and

the Conglomeratic Grit, yielding a Paradoxides fauna.—J. B. **Scrivenor**: The rocks of Pulau Ubin and Pulau Nanas (Singapore). Pulau Ubin and Pulau Nanas are islands set in the eastern entrance to the Straits of Johore, and consist of igneous rocks of considerable interest. Pulau Ubin is composed mainly of hornblende-granite, but a pyroxene-bearing microgranite is found also, while the hornblende-granite is cut by rhombic-pyroxene bearing veins and also contains angular masses of rock resembling the veins. Pulau Nanas consists of dacite-tuffs and dacite, which are referred to the Pahang volcanic series, of Carboniferous or Permo-Carboniferous age. The tuffs and lavas have been altered by the adjacent granite of Pulau Ubin, and contain much secondary biotite and hornblende; their most remarkable feature is the presence of fragments of altered granite. The mutual relations of the different rocks are described. The normal granite of Pulau Ubin is hornblende-granite, the age of which is certainly post-Triassic and pre-Eocene, perhaps post-Inferior-Oolite and pre-Cretaceous. Veins of quartz-norite and masses of quartz-biotite-gabbro, and veins and masses of a fine-grained rock which may be described as enstatite-spessartite, are found in the normal granite of Pulau Ubin. A pyroxene-microgranite and porphyry on Pulau Ubin, and a rock at Changi, having the mineral constitution of an amphibole-vogesite, are described. The dacite-tuffs of Pulau Nanas contain fragments of granite which must be of pre-Carboniferous age, and are referable to the granite of Amboyna. The fragments of granite, and perhaps certain pebbles of schorl-rock, are the only evidence found as yet in the Malay Peninsula of pre-Carboniferous rocks.—J. B. **Scrivenor**: The tourmaline-corundum rocks of Kinta (Federated Malay States). Overlying the limestone on the west side of the Kinta Valley is a thin cap of schists, with which are found certain rocks, the two chief constituents of which are tourmaline and corundum. They are often carbonaceous, and, in the many variations found, white mica, brown mica, pleonaste, rutile, and metallic sulphides occur. The tourmaline-corundum rocks of Kinta consist of varying amounts of tourmaline, corundum, carbon, white mica, spinel, and other minerals. They contain cavities about 6 millimetres in greatest width, generally bordered by a layer of corundum grains, with tourmaline grains on the inside of this border. Sometimes solid bodies similar in size and shape to the cavities occur. Smaller bodies occur, sometimes, but not always, accompanied by the larger cavities and bodies. They consist of tourmaline, of corundum, and of tourmaline and corundum. When both minerals are present the corundum forms a shell to a nucleus of tourmaline. The tourmaline-corundum rocks are associated with other rocks, which lead to the conclusion that the structures described are the result of replacement of the materials of preexisting bodies at the time of extensive granitic intrusions. They also are associated with rocks which point to the original beds having been laid down under conditions similar to those that obtained when the Pahang chert series was deposited. As tourmaline-bearing partings in the limestone at Changkat Pari constitute a case of selective metamorphism, so it is thought that the tourmaline-corundum rocks mark a process of intense metamorphism in beds associated with schists. These beds were probably chert and silicified limestone, both being in many cases carbonaceous. The larger cavities and bodies mentioned are believed to be the result of replacement of oolitic grains. The smaller bodies may be, in part, the result of replacement of the materials forming casts of radiolarian structures.

Mathematical Society, December 9.—Sir W. D. Niven, president, in the chair.—T. H. **Blakesley**: An instrument for the kinematical solution of cubic equations.—A. L. **Dixon**: The eliminant of the equations of four quadric surfaces.

CAMBRIDGE.

Philosophical Society, November 22.—Prof. W. Bateson, F.R.S., president, in the chair.—J. C. F. **Fryer**: Aldabra and neighbouring islands.—Prof. Stanley **Gardiner**: Western Indian Ocean.—D. G. **Lillie**: Notes on the larger Cetacea. It is pointed out that whaling stations have been recently established off the shores of Ireland and Scotland which offer exceptional opportunities for a study of the larger Cetacea. The history of the whaling industry is briefly traced, and a short account given of the modern methods of whaling from notes taken during a visit to the Irish station. The paper also contains a note on the occurrence of hairs in whales. Hairs appear to be absent in Odontocetes. The distribution of hairs in two species of Balænoptera is described, and a reason suggested for the occurrence of hairs in the Mystacoceti.—G. N. **Watson**: The continuations of functions defined by generalised hypergeometric series.—L. **Vegard**: Some general properties of mixed solutions.

MANCHESTER.

Literary and Philosophical Society, November 30.—Mr. Francis Jones, president, in the chair.—Prof. E. **Rutherford**: The action of the α rays on glass. The author recently reproduced the conditions under which pleochroic halos, such as have been observed in mica, would be formed, by enclosing a large quantity of radium emanation in a fine capillary tube of soda glass. When looked at under the microscope the walls of the tube were seen to be surrounded by a well-defined halo about 0·4 mm. in depth, which was equivalent to the maximum distance of the α particle from the active matter. This result confirms the correctness of the explanation given by Joly of haloes in mica, as being due to small inclusions of radio-active material.—Dr. B. B. **Boltwood** and Prof. **Rutherford**: Production of helium by radium. After mentioning that Rutherford, Geiger, and Royds had shown that the α particle was an atom of helium, and that Rutherford and Geiger had also calculated, by counting the α particles, that 1 gram of radium in equilibrium should produce 158 cubic mm. of helium per year, the authors state that they have recently made a determination of the rate of production of helium by actually measuring the volume produced. They used a barium-radium salt containing about 200 milligrams of radium, loaned to one of them by the Vienna Academy of Sciences. The experiments gave a result corresponding to the production of helium at the rate of 163 cubic mm. per gram of radium per year. Sir James Dewar last year made systematic measurements which indicated that helium was produced at a constant rate equivalent to 135 cubic mm. per gram of radium per year.—Dr. A. N. **Meldrum**: Development of the atomic theory, i., Berthollet's doctrine of variable proportions. The controversy between Berthollet and Proust at the beginning of the nineteenth century as to whether the composition of chemical substances is variable or not has been greatly misunderstood. The histories of chemistry represent Berthollet as a "person who had preposterous notions" about the composition of chemical substances, and was "deservedly annihilated" by Proust. A study of the period shows that Berthollet's teaching, having easily survived the criticisms of Proust, was refuted by Dalton's teaching, and that the doctrine of fixed proportions was only then put on a sound basis.

PARIS.

Academy of Sciences, December 6.—M. Bouchard in the chair.—The number of foreign associates has been increased from eight to twelve.—H. **Poincaré**: Curves traced on algebraic surfaces.—T. **Carpentier**: Remarks on an isothermal barometer invented by the Marquis de Montrichard.—C. **Guichard**: Surfaces such that the tangents to a series of lines of curvature touch a quadric.—D. **Cirera**: The magnetic disturbance of September 25, 1909. Details of observations made at the Observatory of Ebro.—J. Comas **Sola**: *Résumé* of observations of Mars, made at the Fabra Observatory, Barcelona, during the opposition of 1909. These observations were made with the double Mailhat equatorial of 38-cm. aperture, the atmospheric conditions in October being extremely good. The main topographical details of Mars are invariable, but this is not the case with the smaller details. A diagram of a portion of the planet accompanies the paper.—Ch. **Nordmann**: A new approximation in the study of the effective temperatures of the stars. These results are based on the application of Planck's radiation law to the spectrophotometrical measurements described in an earlier paper. The temperatures found range from 2870° for ρ Perseus, 5320° for the sun, to δ Perseus 18,500°, and λ Taurus more than

40,000°.—M. **Maneng**: Observations of a small planet, probably new. The elements have been determined from photographs taken by M. Boinot on October 19 and 23.—M. **Tilho**: The precision of determinations of longitude on land by the chronometer, according to observations by the Niger-Tchad expedition. A comparison of the results obtained for differences of longitude by the telegraph, direct-length measurement, and the chronometer show that the last-named agrees very satisfactorily with the other methods.—Eugène **Fabry**: The order of a Taylor's series.—M. **Galbrun**: The representation of the solution of an equation of finite differences for large values of the variable.—Arnaud **Denjoy**: Completely discontinuous ensembles.—D. **Pompéiu**: Discontinuous singularities of uniform analytical functions.—J. **Haag**: Families of Lamé composed of helicoids.—René **Garnier**: Surfaces of the fourth order which admit of an infinite discontinuous group of birational transformations.—L. **Remy**: The birational transformations of surfaces of the fourth order with doubly isolated points.—M. **Ravigneaux**: The generalisation of the formula of Willis on epicycloidal trains.—Hector **Pécheux**: The electrical properties of steels. Measurements are given of the resistances at various temperatures and thermoelectromotive forces (against copper) of four steels, ranging in quality from very soft to hard.—André **Léauté**: The mathematical study of the heating of a conductor traversed by a very rapid oscillatory discharge.—C. E. **Guye** and V. **Freedericksz**: The internal friction of solids at low temperatures. Studies of the torsion of wires of silver, aluminium, gold, magnesium, iron, and quartz at temperatures between 100° C. and −196° C.—H. **Baubigny**: The estimation of dithionic acid and the dithionates. Accurate results were obtained only by the dry method, fusion with a mixture of alkaline carbonate and nitrate.—Marcel **Delépine**: The chloroiridates and chloroiridites of silver and thallium.—G. D. **Hinrichs**: The calculation of atomic weights: the solution of the equation of condition.—A. **Colson**: The reduction of sodium sulphate by carbon. A mixture of lampblack and sodium sulphate reacts rapidly at 950° C., 70 per cent. of the sulphate being decomposed in twenty minutes.—J. A. **Muller**: The phase rule. A reply to the criticism of M. Boulouch.—G. **Leser**: The two isomeric hexamethylene β-diketones.—H. **Arsandaux**: Contribution to the study of lateritic formations.—A. **Maige**: The formation of heterotypical chromosomes in *Asphodelus microcarpus*.—G. **Perrin**: Fertilisation in the prothallus of *Pteris tremula*.—J. **Dumont**: The layers surrounding earthy particles. Sand grains separated from soil by simple levigation are generally coated with a colloidal layer, removable by solutions of oxalic acid. The amount of this layer is shown to depend on the size of the particles.—G. **Grandidier**: The description of a new bird, *Monias benschi*, from Madagascar.—Louis **Roule**: Amphibians of the genus Euproctus.—B. **Collin**: Preliminary diagnoses of some new or badly known Acinetæ.—L. **Cayeux**: The secondary quartz of the Silurian oolitic iron minerals of France, and its replacement in the lower layers by iron carbonate.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 16.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some Quantitative Measurements in Connection with Radio-telegraphy: Dr. J. A. Fleming, F.R.S.—Efficiency of Short Spark Methods of Generating Electrical Oscillations: Dr. W. H. Eccles and A. J. Makower.

LINNEAN SOCIETY, at 8.—Report on the Crustacea Isopoda and Tanaidacea collected by Mr. C. Crossland in the Sudanese Red Sea: Rev. T. R. R. Stebbing, F.R.S.—Pycnogonida from the Red Sea and Indian Ocean collected by Mr. C. Crossland: Prof. G. H. Carpenter.—On a Collection of Blattidæ preserved in Amber from Prussia: R. Shelford.—Isopoda from the Indian Ocean and British East Africa: Rev. T. R. R. Stebbing, F.R.S.—The Bryozoa from Collections made by Mr. C. Crossland, Part II., Cyclostomata, Ctenostomata, Endoprocta: A. W. Waters.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, DECEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Mild-steel Tubes in Compression and under Combined Stress: W. Mason.—Compound Stress Experiments: C. A. M. Smith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Foundation and Construction of Dock Walls: H. T. Tudsbery.

MONDAY, DECEMBER 20.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: C. C. Turner.

INSTITUTE OF ACTUARIES, at 5.—On the Mortality of Female Assured Lives, with Graduated Tables deduced from the British Offices' Experience, 1863–1893: C. W. Kenchington.

TUESDAY, DECEMBER 21.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Railway-Signalling in India: C. W. Hodson.—*Probable Paper*: The Design of Rolling Stock for Smooth-rail Working on Heavy Gradients: F. W. Bach.

CONTENTS.